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Yoshikawa et al.

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(54) **FIXING DEVICE HAVING PRESSURE RELEASE MEMBER SUPPORTED RECIPROCABLY, AND IMAGE FORMING APPARATUS EQUIPPED THEREWITH**

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(73) Assignee: **Sharp Kabushiki Kaisha**, Osaka (JP)

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G03G 15/20 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/2064*** (2013.01); *G03G 15/2032* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/2064; G03G 15/2032
USPC 399/122
See application file for complete search history.

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(57) **ABSTRACT**

A fixing device is configured to move the pressure release member in predetermined movement directions relative to the support member such that the biasing member can function. The support member has a first retaining part. The pressure release member has a retention element to be held in the first retaining part of the support member. When the retention element is held in the first retaining part of the support member, the pressure release member is configured to apply a biasing force of the biasing member to the support member and thereby to cause the second fixing member to be pressed against the first fixing member. When the retention element is released from the first retaining part of the support member, the pressure release member is configured to stay at a release position in the movement directions at which position the biasing member ceases to apply the biasing force to the support member, and thereby to release the pressure contact state where the second fixing member is pressed against the first fixing member.

12 Claims, 15 Drawing Sheets

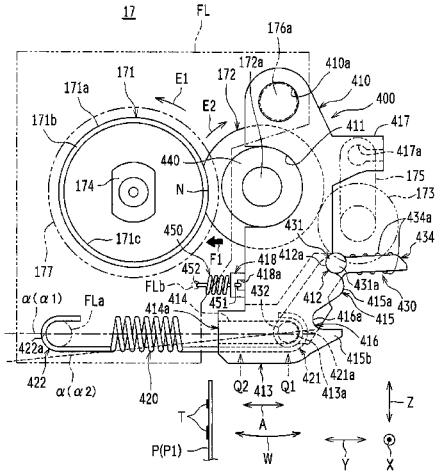
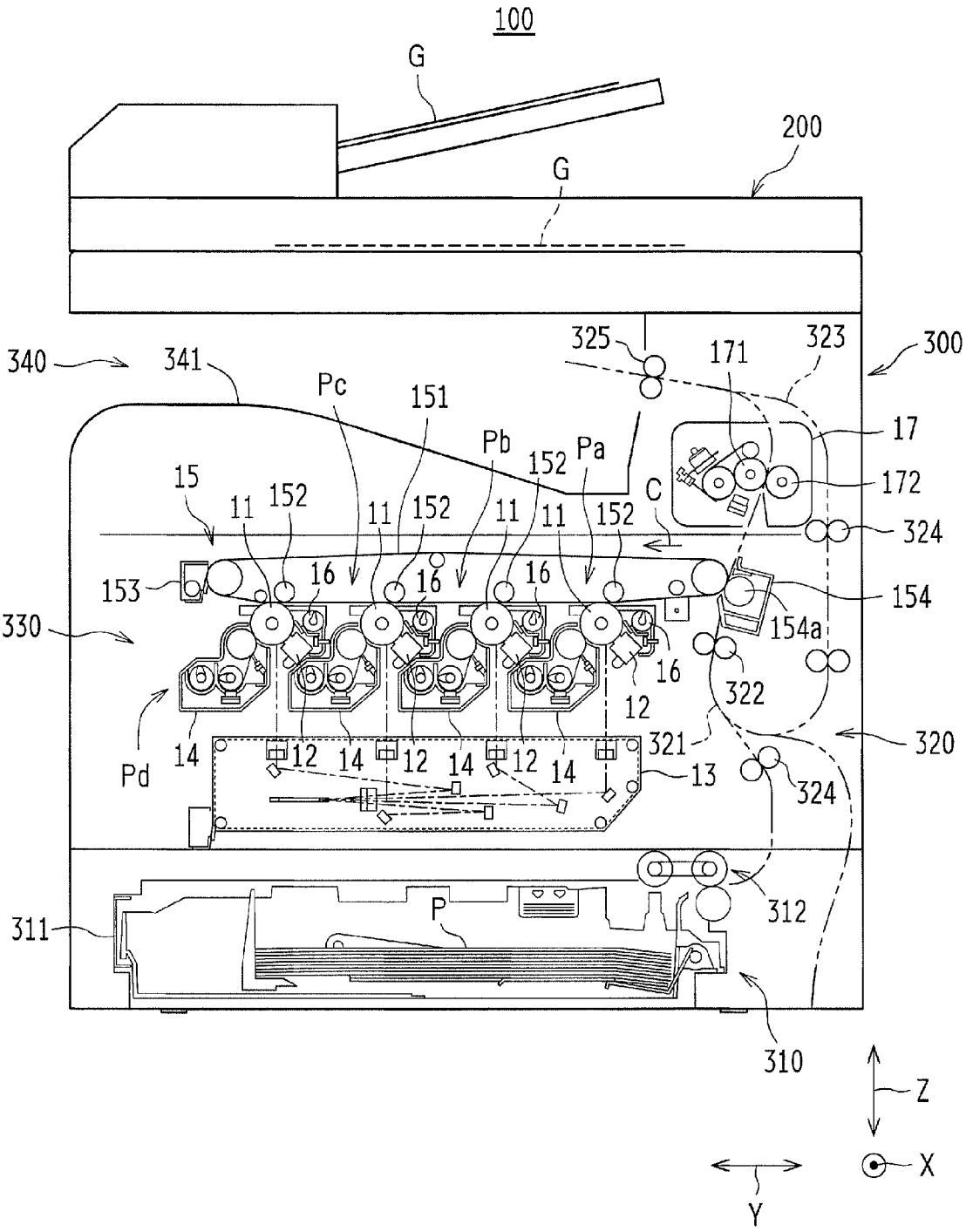


FIG.1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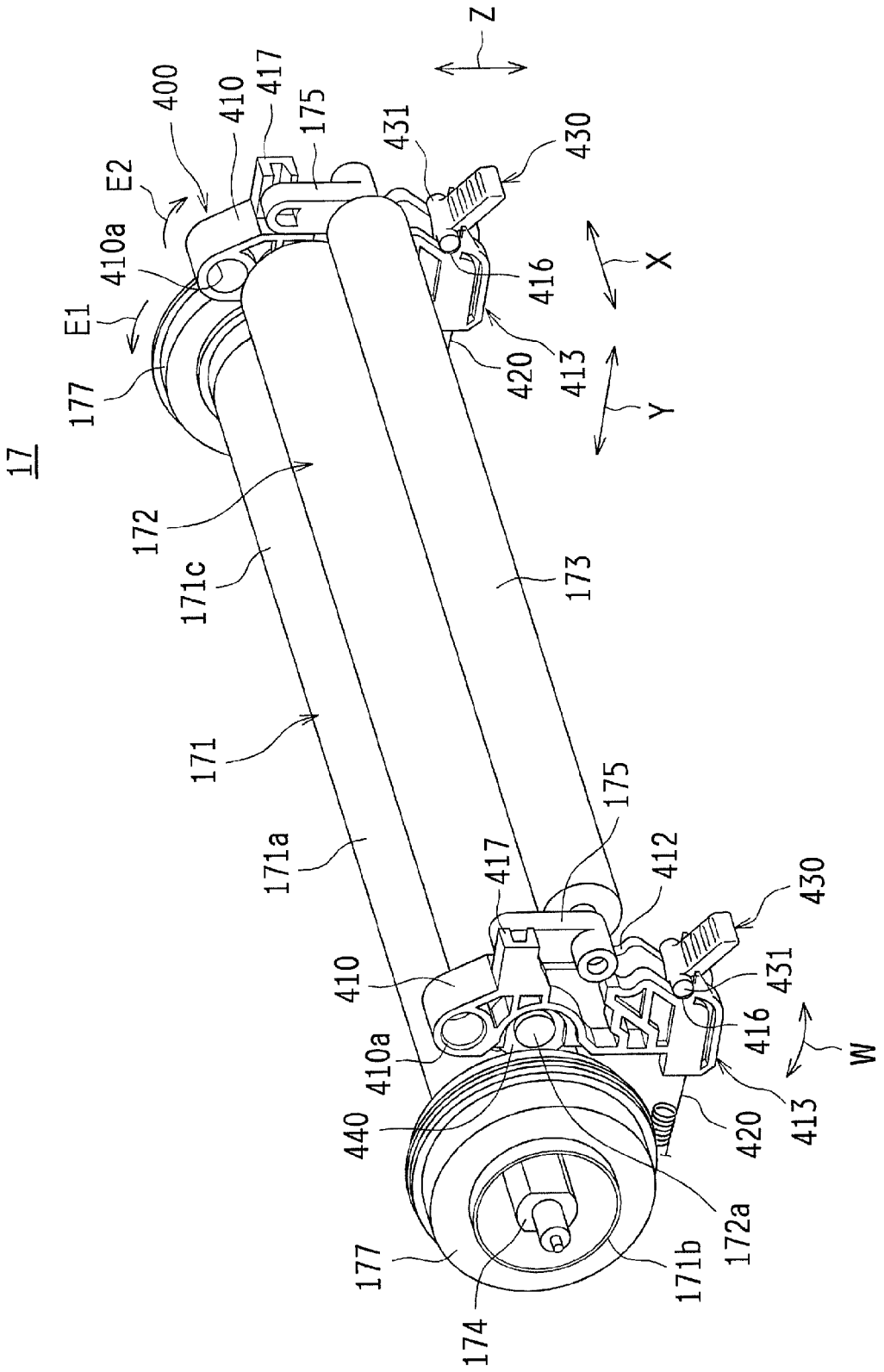
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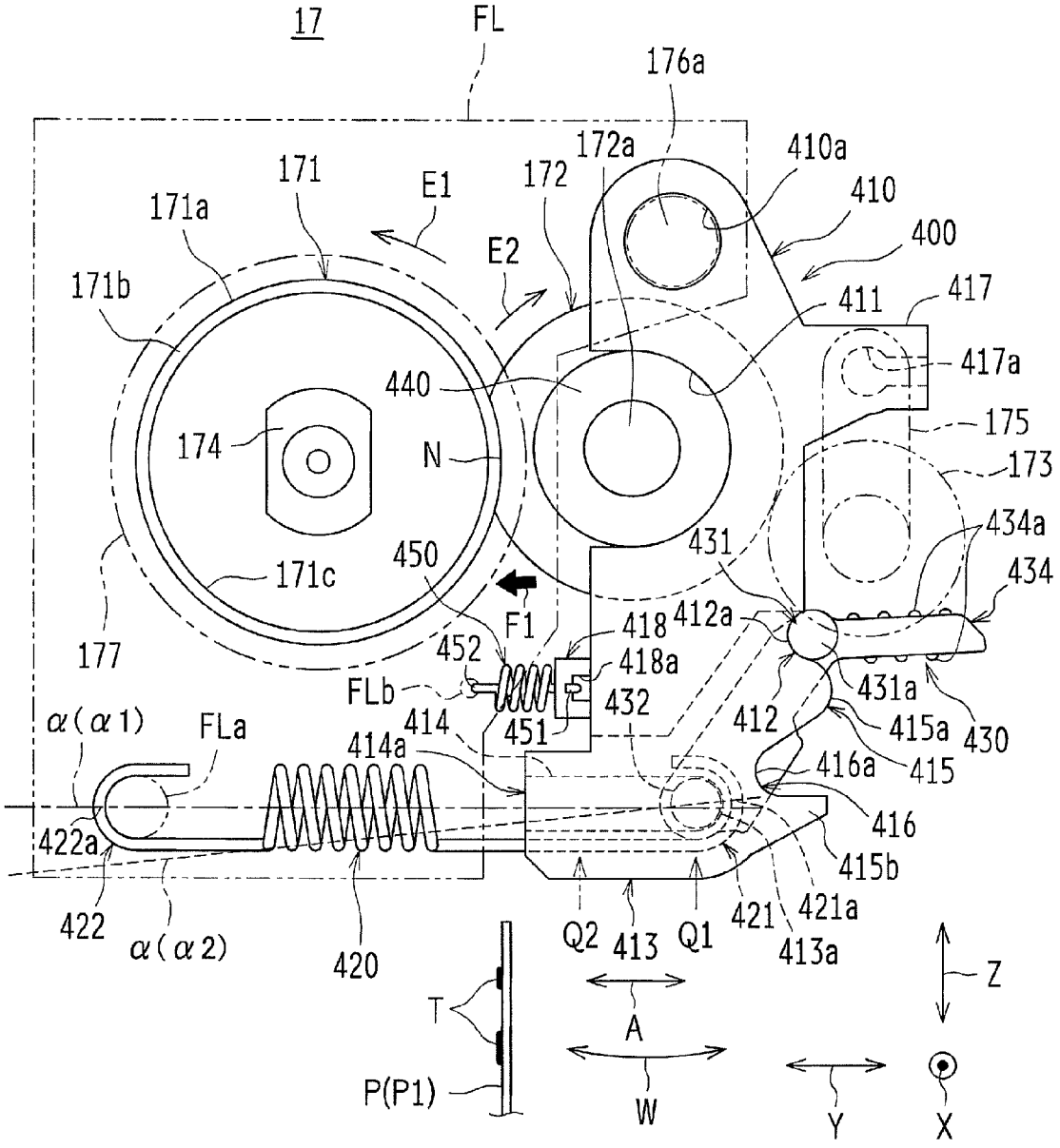
W

FIG.2

FIG.3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N
173
434a
431
171c
450
434
F1
418
412a
177
452
418a
FLb
431a
432
412
415a
430
α(α1)
FLa
414
451
415
414a
416a
422a
416
415b
422
α(α2)
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421a
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A
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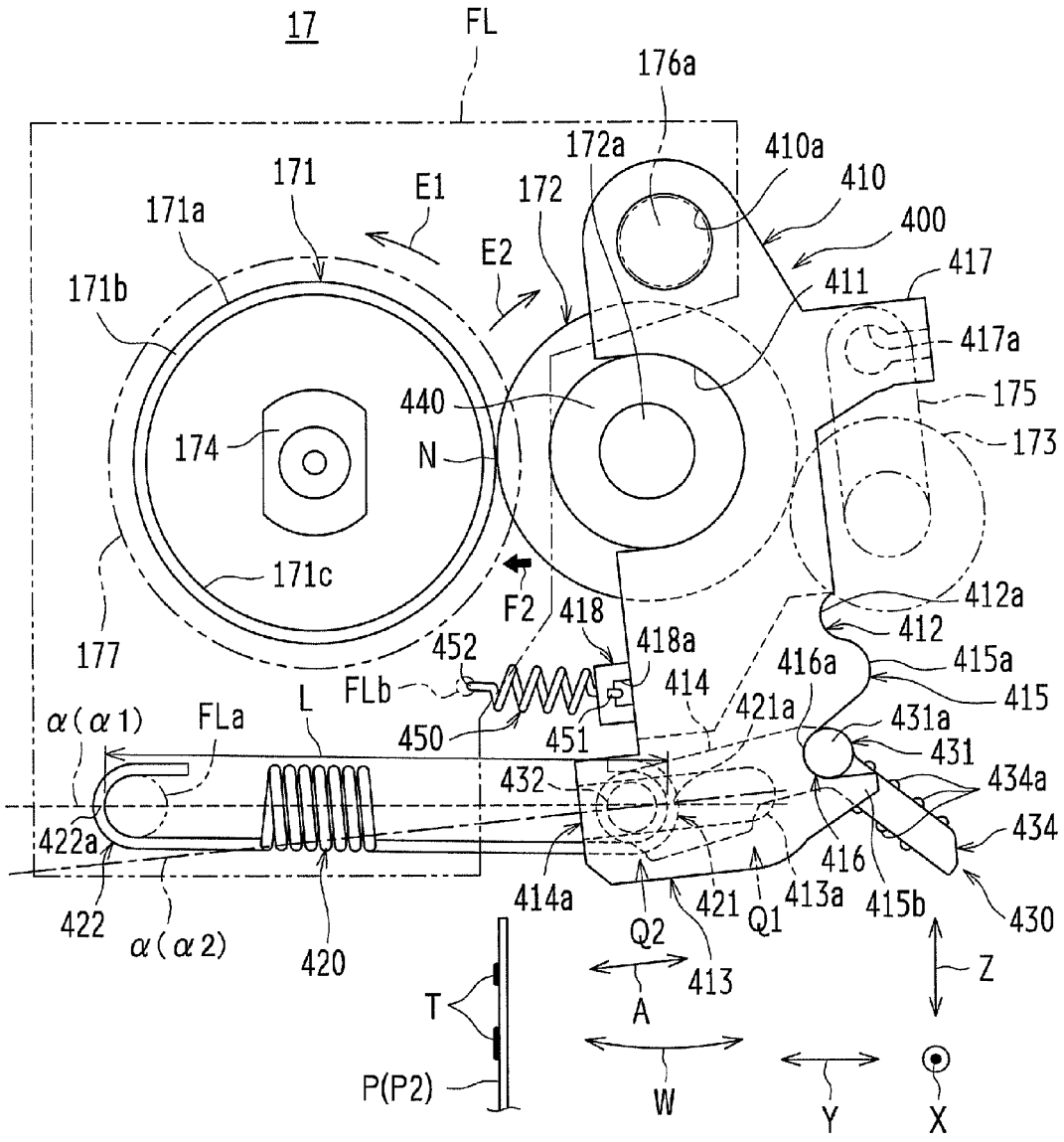
W
Y
X

FIG.4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171c
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F2
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415a
415
416a
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421a
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431
434a
434
FLb
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L
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450
451
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422
α(α2)
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A
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Y
X

FIG.5A

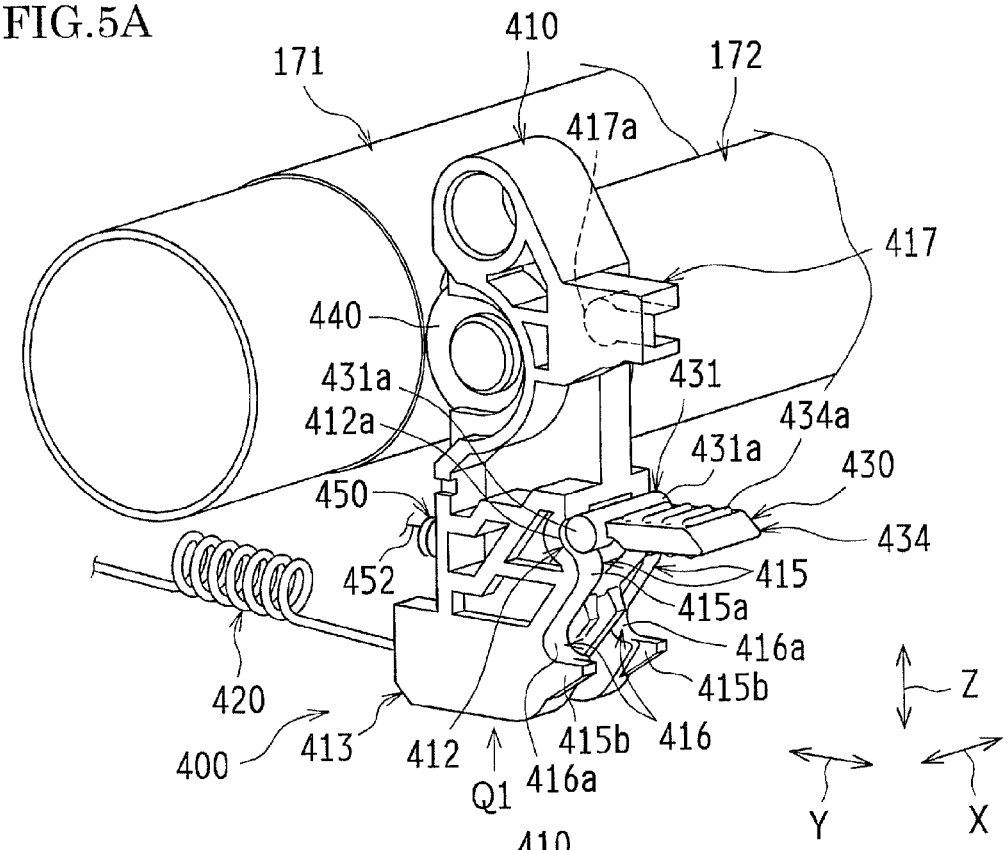
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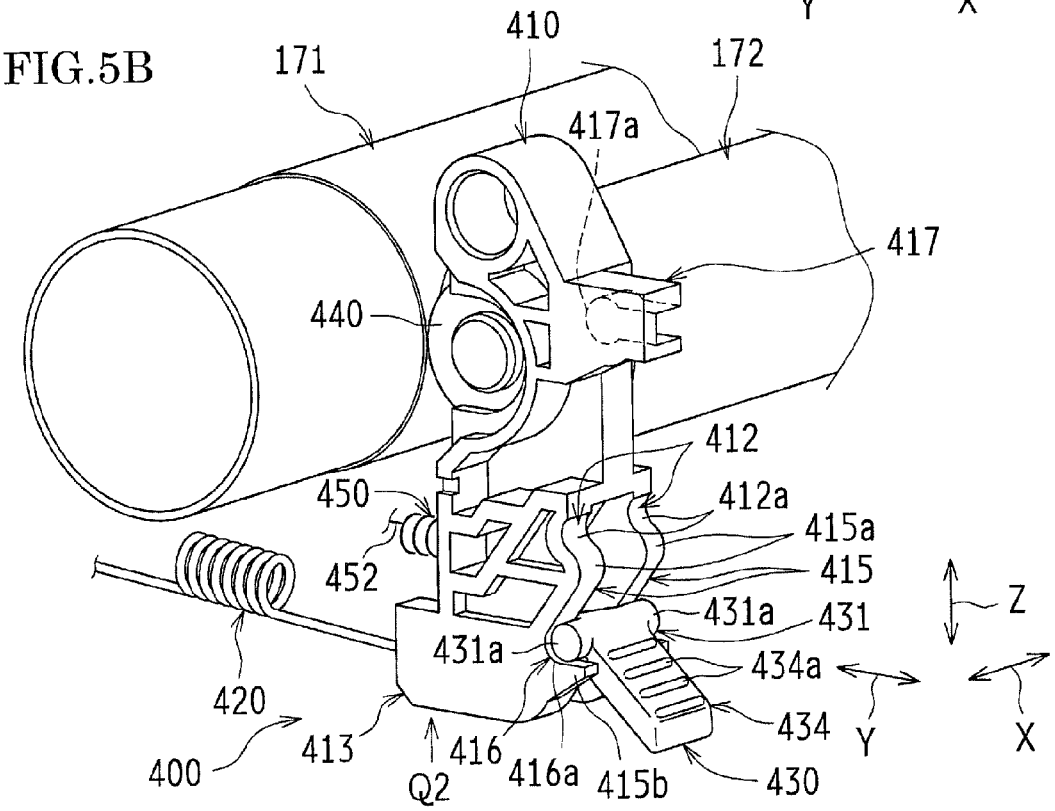
FIG.5B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Q2

FIG.6A

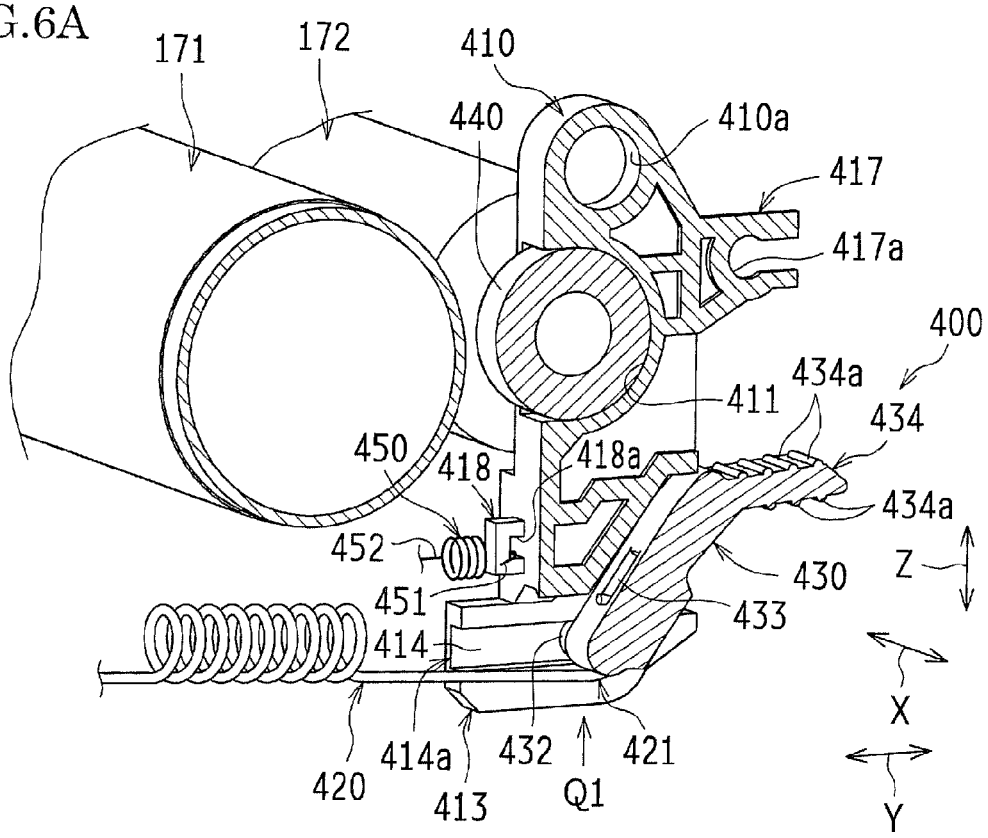
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FIG.6B

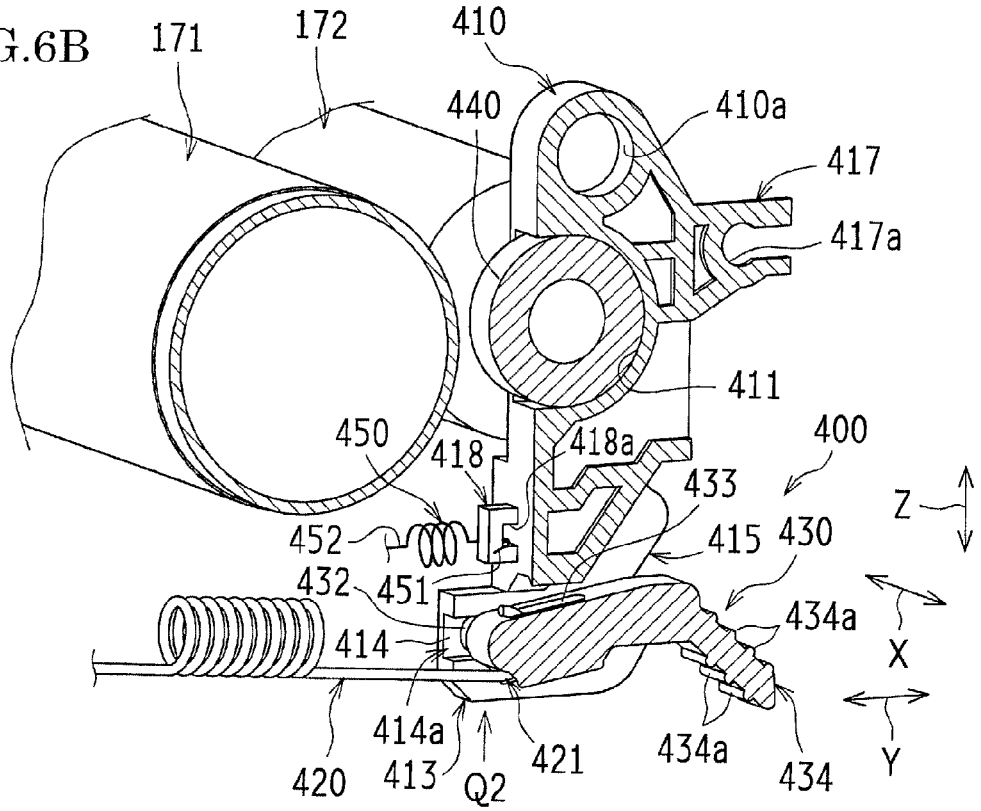
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FIG.7A

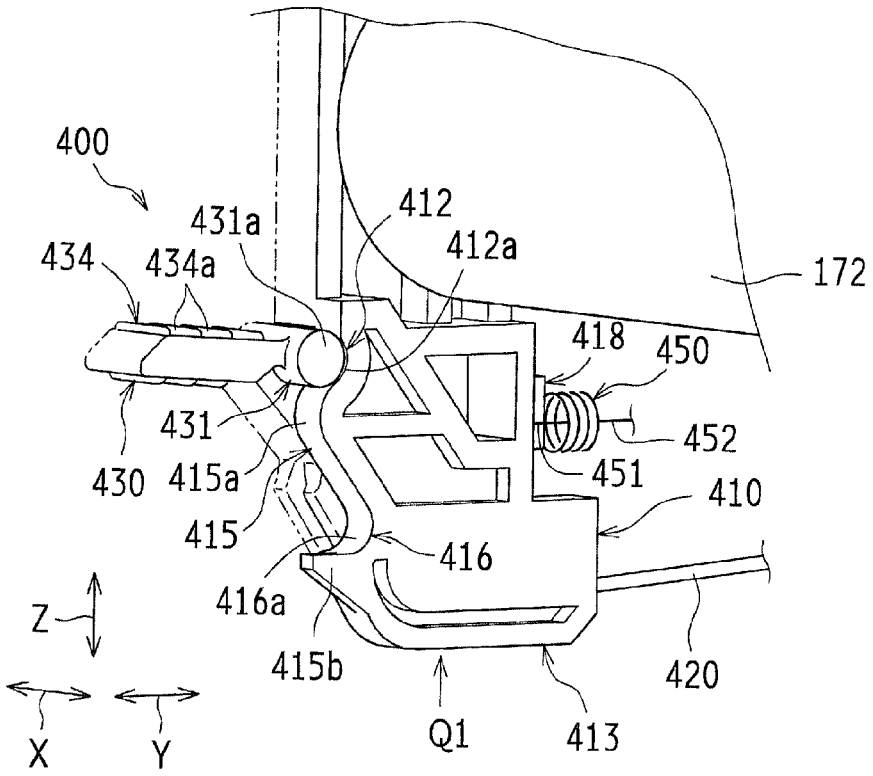
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FIG.7B

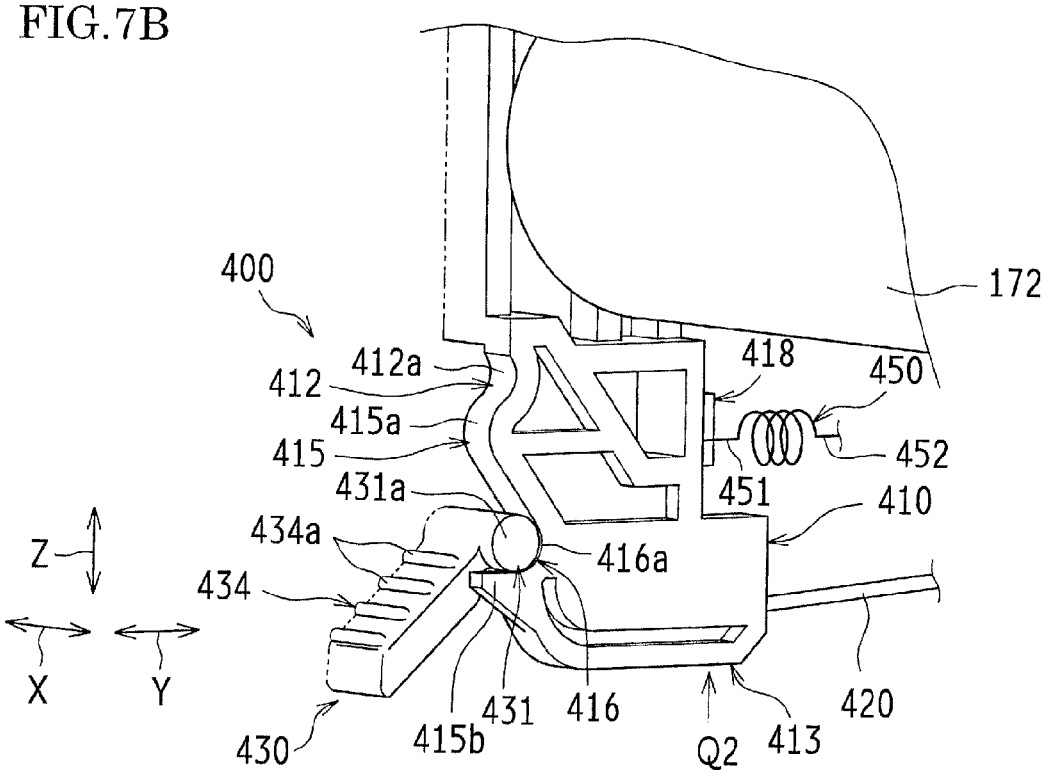
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FIG.8

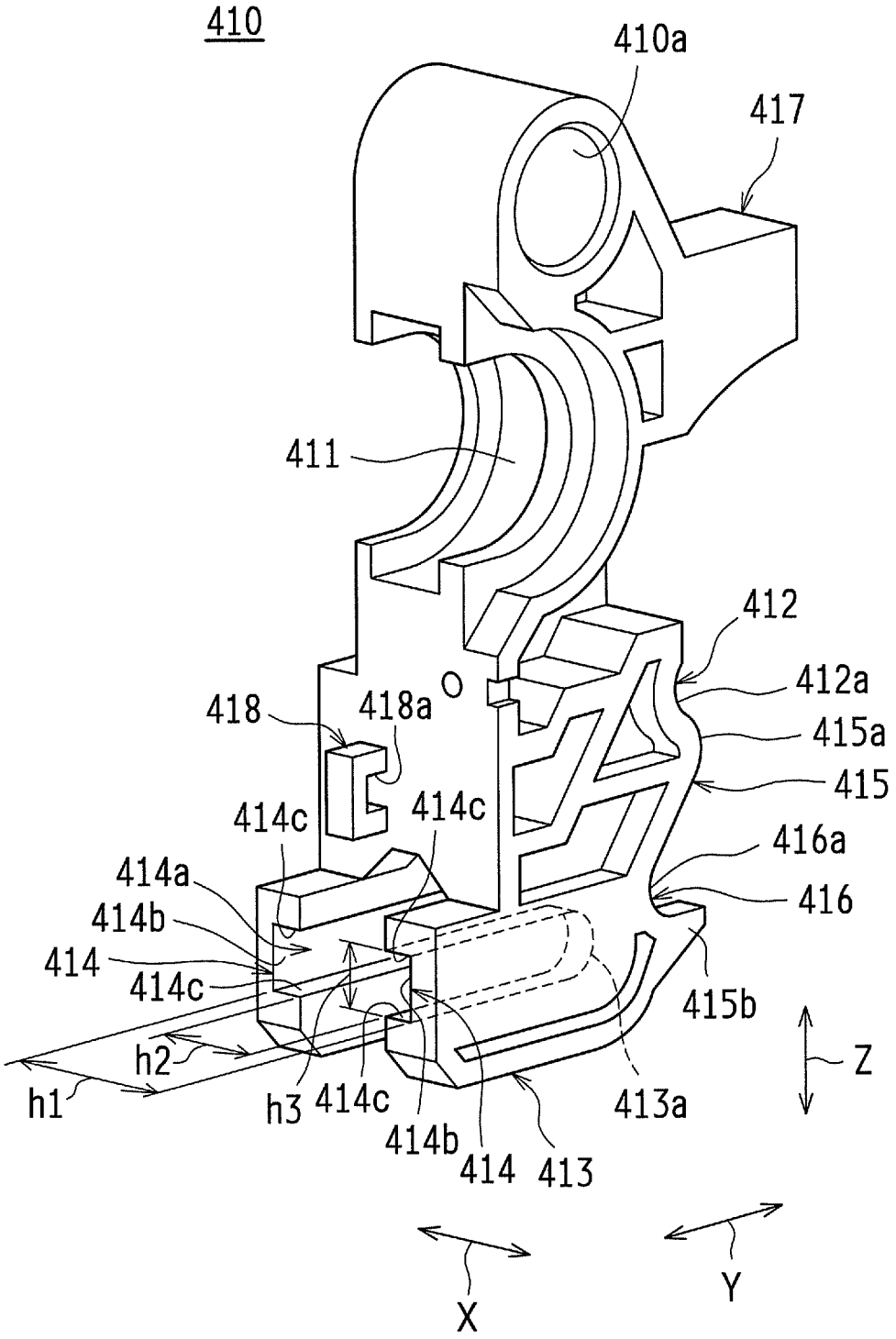
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FIG.9

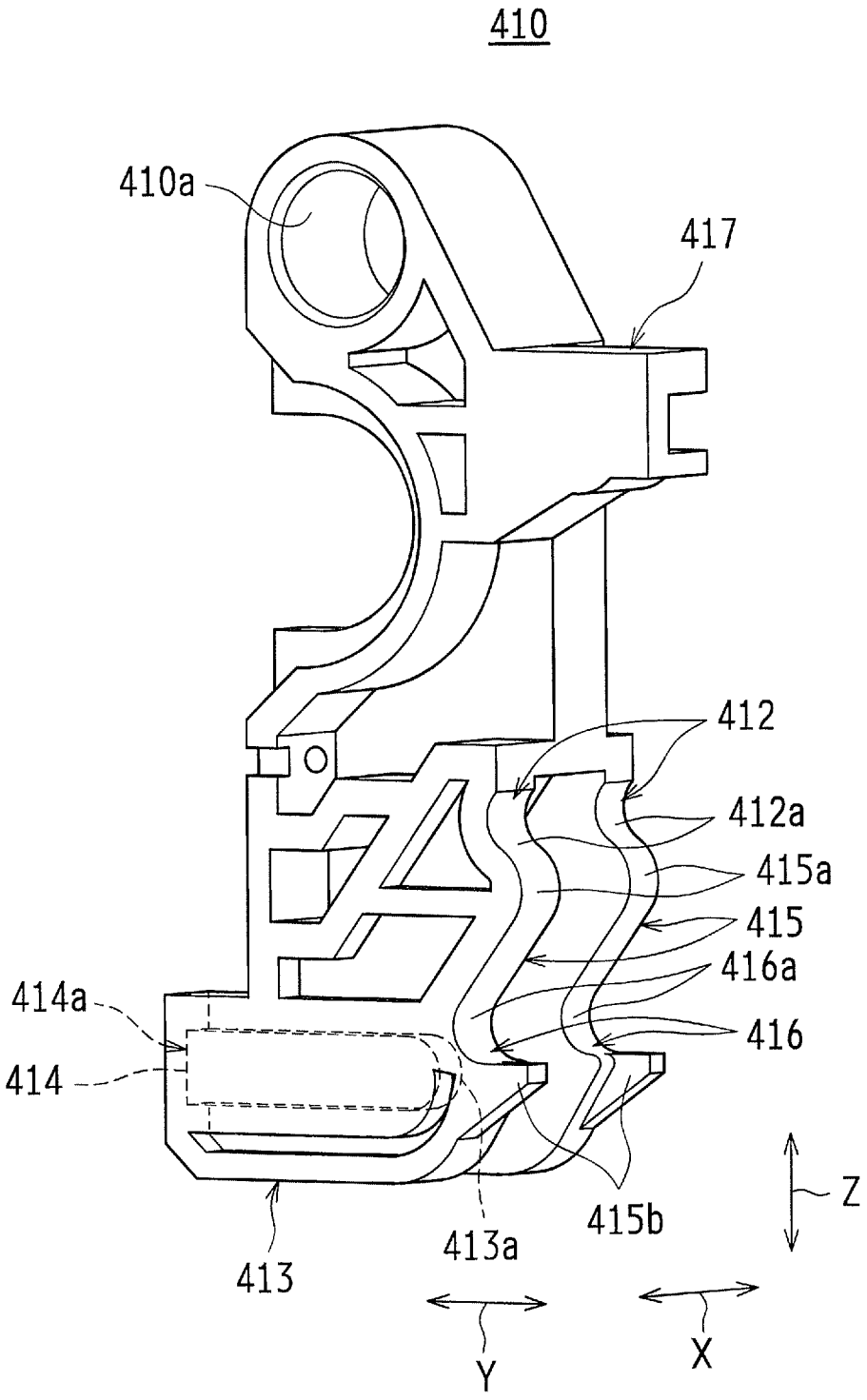
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FIG.10

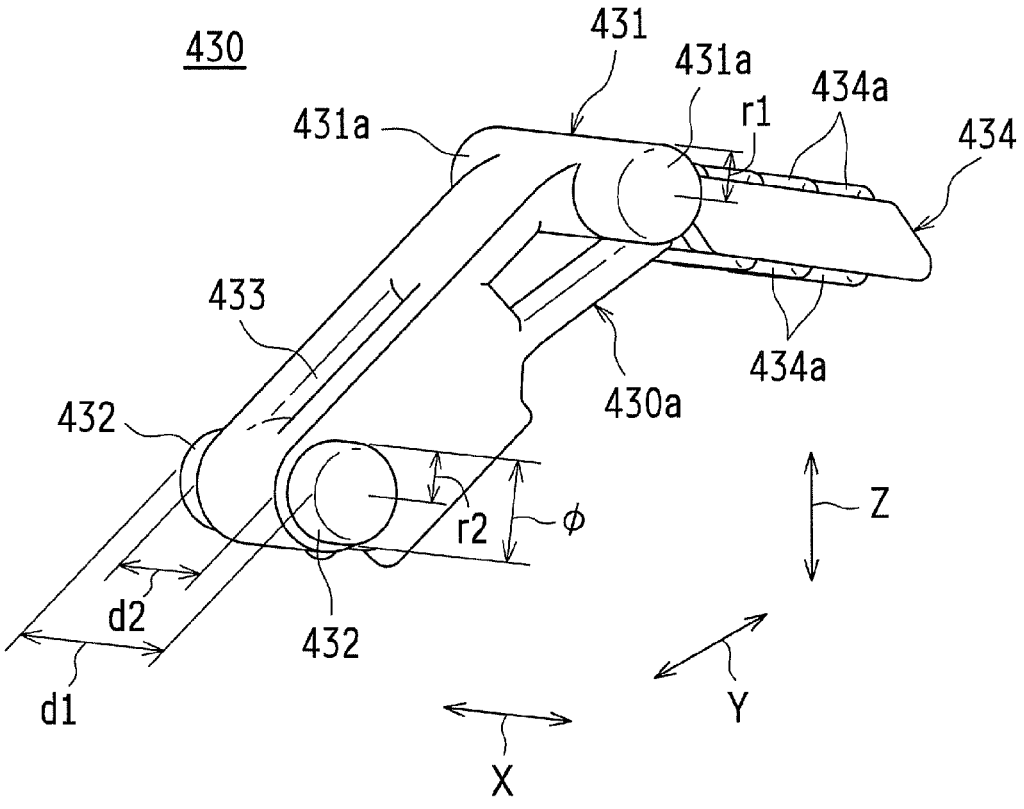
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FIG.11

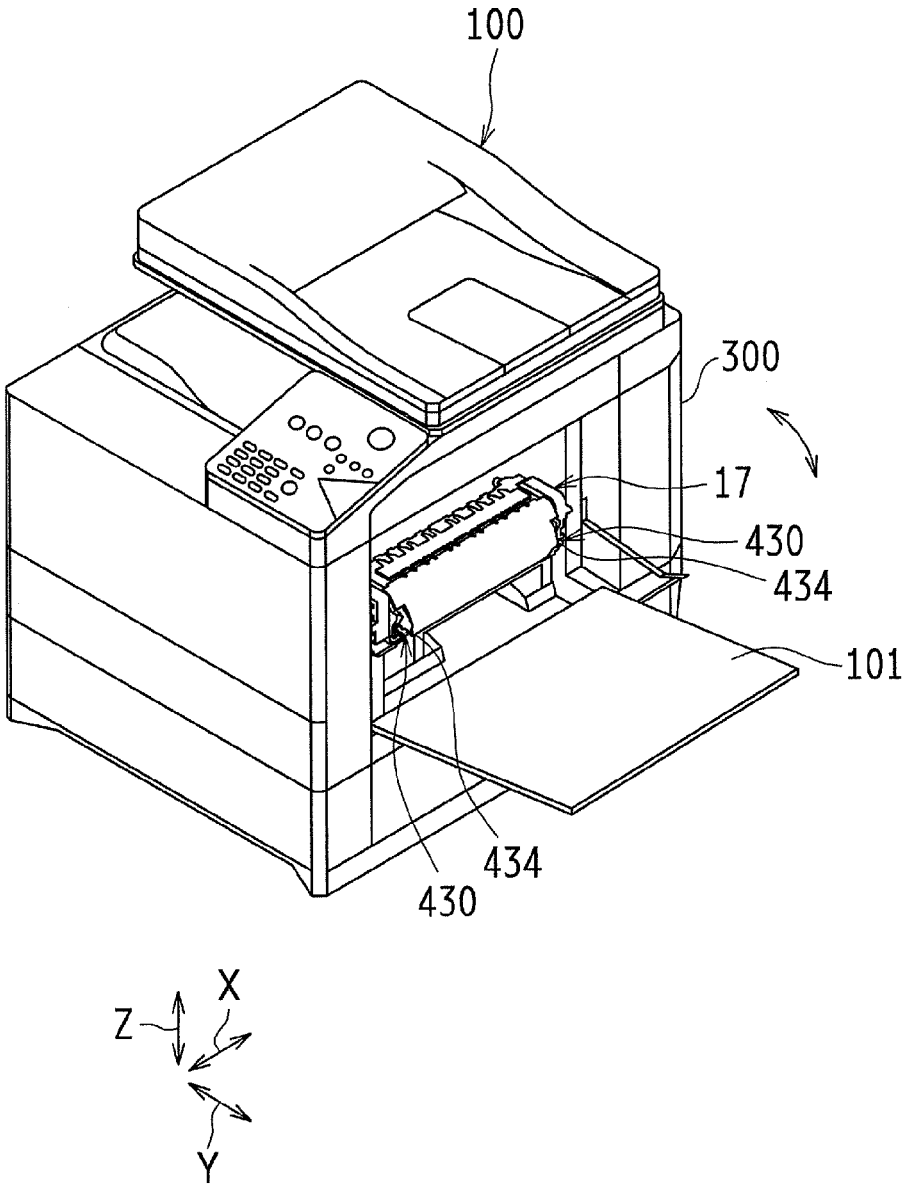

FIG.12

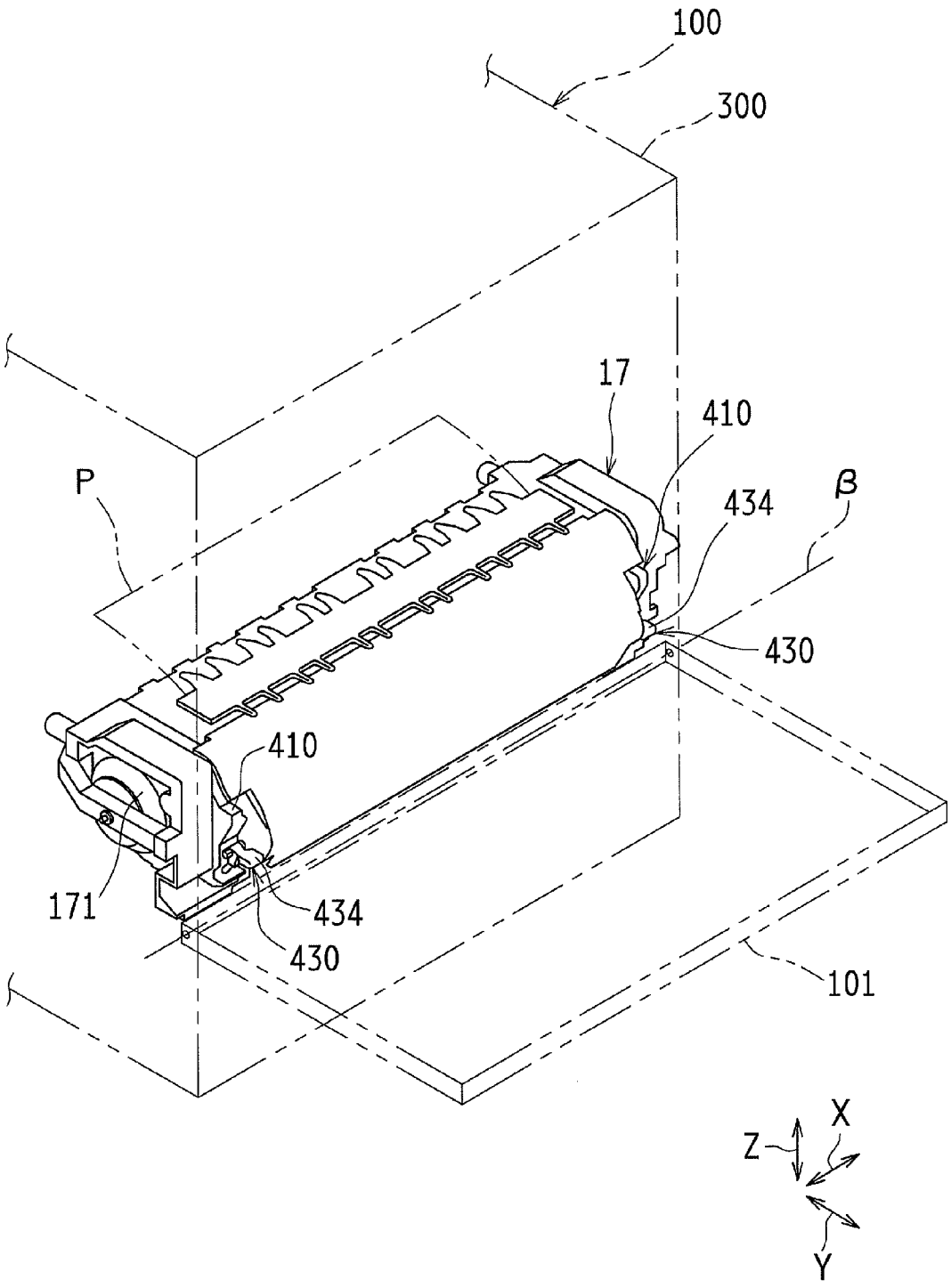

FIG.13

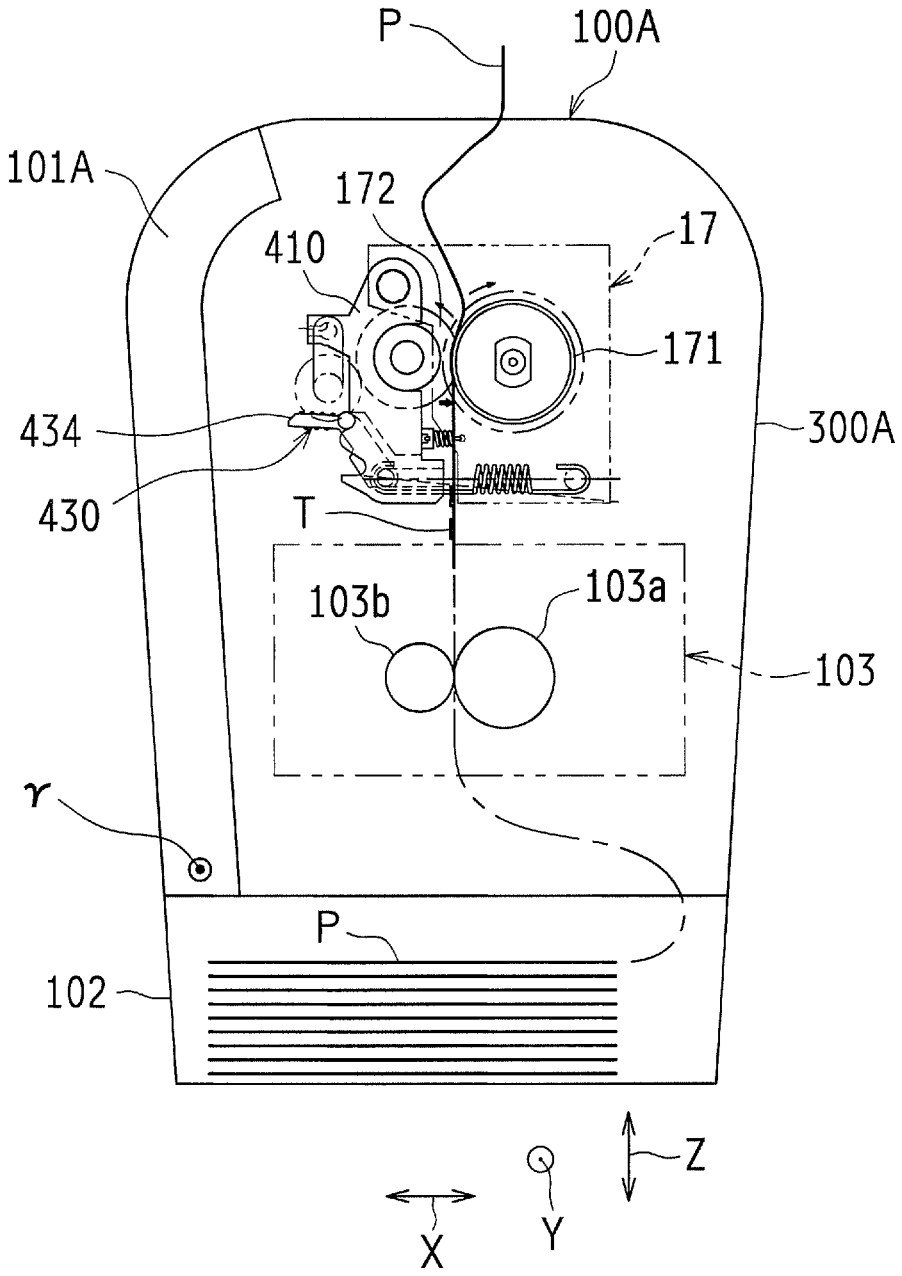
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FIG.14

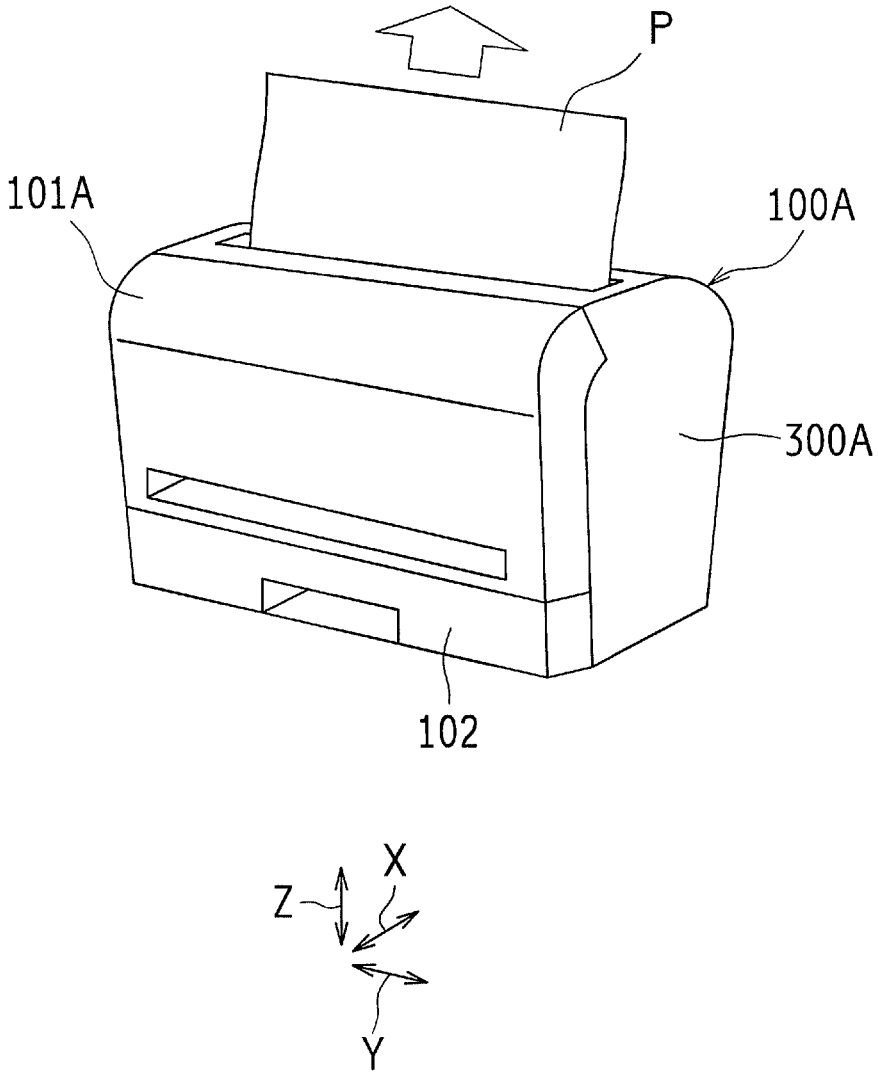
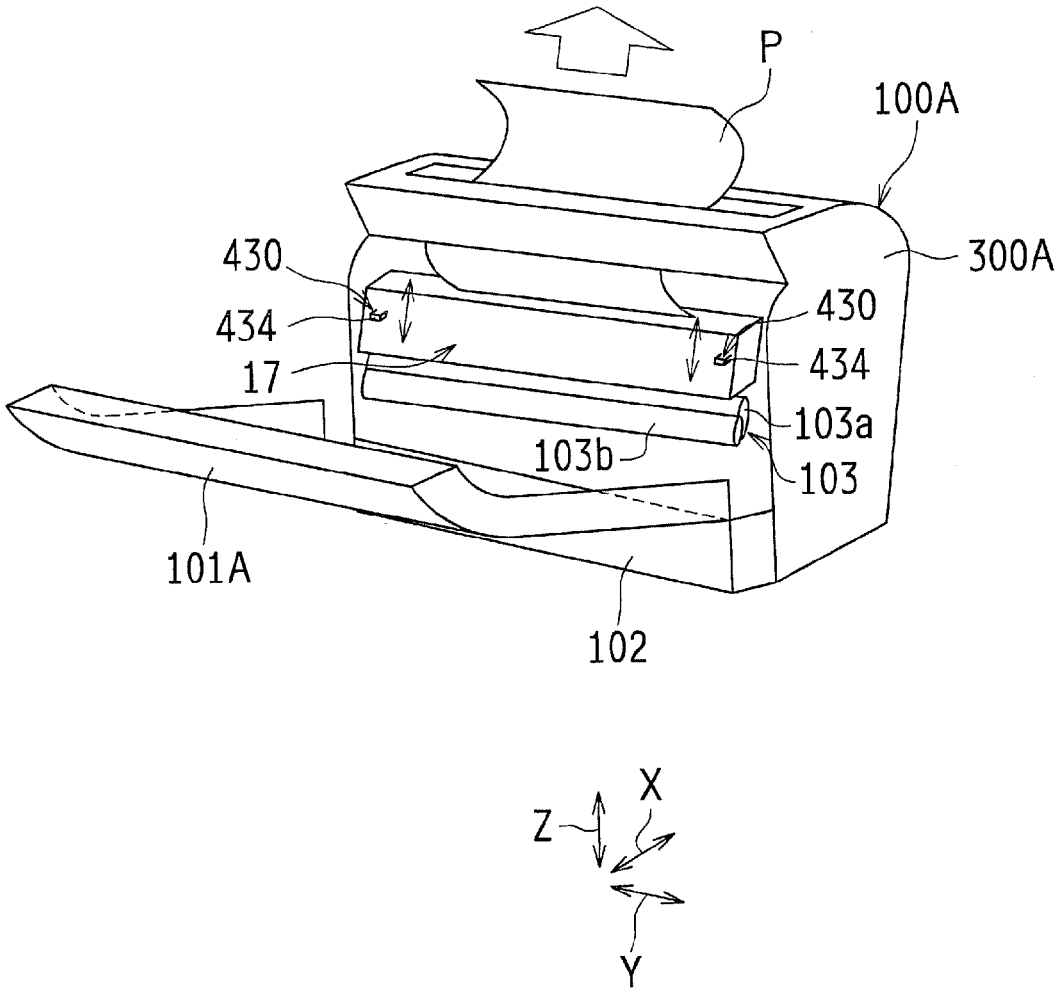


FIG.15



FIXING DEVICE HAVING PRESSURE RELEASE MEMBER SUPPORTED RECIPROCABLY, AND IMAGE FORMING APPARATUS EQUIPPED THEREWITH

CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims priority under 35 U.S.C. §119(a) to Japanese Patent Application No. 2013-068758, filed Mar. 28, 2013. The contents of this application are incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

The present invention relates to a fixing device applicable to an electrophotographic image forming apparatus such as a copying machine and a printer, and also relates to an image forming apparatus.

An electrophotographic image forming apparatus such as a copying machine and a printer may employ a pressure release member which presses a second fixing member (e.g. a pressure roller) against a first fixing member (e.g. a rotational fixing member such as a fixing roller and a fixing belt) by a biasing member with a predetermined pressing force, and which releases this pressure contact state where the second fixing member is pressed against the first fixing member with a predetermined pressing force.

As an example of the pressure release member, a fixing device disclosed in JP 2008-151965 A employs a cam having a large-diameter part and a small-diameter part. By utilizing the large-diameter part and the small-diameter part, this cam switches between a pressure contact state where a fixing roller (a first fixing member) and a pressure roller (a second fixing member) are pressed against each other and a released state where the pressure contact is released.

As another example of the pressure release member, a fixing device disclosed in JP 2003-223075 A employs a cam which abuts an end of a roller shaft of a pressure roller (a second fixing member) and which displaces the pressure roller in a direction away from a fixing roller (a first fixing member) against a biasing force of a spring.

As yet another example of the pressure release member, a fixing device disclosed in JP 2001-318555 A employs a cam by which a downward rotational movement of a release lever around a rotational shaft is converted into an upward rotational movement of a pressure lever around a first rotational shaft. By this converting action, the cam releases a pressure state where a pressure roller (a second fixing member) is pressed against a heating roller (a first fixing member).

In these conventional fixing devices, cams are used as the pressure release members for releasing the pressure contact state where the second fixing members are pressed against the first fixing members. However, this configuration requires a number of components for operating the pressure release members, and further requires a greater space and higher costs for such components.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a fixing device which requires a fewer number of components for operating a pressure release member and thereby reduces an installation space and costs for the fixing device. Another object of the present invention is to provide an image forming apparatus equipped with this fixing device.

In order to achieve these objects, the present invention provides a fixing device including a first fixing member, a second fixing member opposed to the first fixing member, a support member which supports the second fixing member such that the second fixing member can approach and separate from the first fixing member, a biasing member which biases the support member such that the second fixing member is pressed against the first fixing member, and a pressure release member which releases a pressure contact state where the second fixing member is pressed against the first fixing member. The fixing device is configured to move the pressure release member in predetermined movement directions relative to the support member such that the biasing member can function, the movement directions being set in advance. The support member includes a first retaining part for retaining the pressure release member at a pressure position in the movement directions at which position the biasing member functions. The pressure release member includes a retention element to be held in the first retaining part of the support member. When the retention element is held in the first retaining part of the support member, the pressure release member is configured to apply a biasing force of the biasing member to the support member and thereby to cause the second fixing member to be pressed against the first fixing member. When the retention element is released from the first retaining part of the support member, the pressure release member is configured to stay at a release position in the movement directions at which position the biasing member ceases to apply the biasing force to the support member, and thereby to release the pressure contact state where the second fixing member is pressed against the first fixing member. The present invention also provides an image forming apparatus equipped with the fixing device according to the present invention.

As an exemplary embodiment of the present invention, the pressure release member may include a shaft extending in an orthogonal direction that is orthogonal to the movement directions, and the support member may include a guide unit which supports the shaft of the pressure release member reciprocably in the movement directions.

As another exemplary embodiment of the present invention, the guide unit may have a guide groove which guides the shaft of the pressure release member in a freely movable manner in the movement directions, and the guide groove may have an opening which is open to an outside and through which the shaft of the pressure release member is attachably and detachably inserted.

As yet another exemplary embodiment of the present invention, the biasing member may have one end thereof located on the shaft of the pressure release member, and may have the other end thereof located on a support member for supporting the first fixing member. In this case, the other end of the biasing member is positioned on a first imaginary straight line extending in the movement directions in the pressure contact state where the second fixing member is pressed against the first fixing member, on a second imaginary straight line in a pressure contact release state where the second fixing member is not pressed against the first fixing member, or in an area between the first imaginary straight line in the pressure contact state where the second fixing member is pressed against the first fixing member and the second imaginary straight line in the pressure contact release state where the second fixing member is not pressed against the first fixing member.

As still another exemplary embodiment of the present invention, the retention element of the pressure release member may include a projecting portion which projects in the orthogonal direction that is orthogonal to the movement

directions. The support member may be configured to support the shaft of the pressure release member at the guide unit in such a manner that the shaft of the pressure release member can freely turn about a central axis of the shaft. The support member may include a sliding contact portion along which the projecting portion is caused to slide by the biasing force of the biasing member when the pressure release member stays between the pressure position and the release position.

As a further exemplary embodiment of the present invention, the first retaining part of the support member may have a first concave portion formed in the sliding contact portion. The first concave portion may be configured to catch the projecting portion of the retention element when the pressure release member stays at the pressure position.

As an even further example exemplary embodiment of the present invention, the support member may include a second retaining part which holds the retention element of the pressure release member at the release position. The second retaining part may have a second concave portion formed in the sliding contact portion. The second concave portion may be configured to catch the projecting portion of the retention element when the pressure release member stays at the release position.

As a still further exemplary embodiment of the present invention, the support member may be provided with a sloping convex portion in the sliding contact portion between the first concave portion and the second concave portion.

As a different exemplary embodiment of the present invention, the second concave portion may be provided with a first regulating portion which limits movement of the projecting portion of the retention element of the pressure release member in a side opposite to the first concave portion.

As another different exemplary embodiment of the present invention, the guide unit may be provided with a second regulating portion which limits movement of the shaft of the pressure release member in a direction away from the first fixing member.

As a further different exemplary embodiment of the present invention, the biasing member may have a free length when the pressure release member stays at the release position.

As a yet different exemplary embodiment of the present invention, the pressure release member may include a grip which is oriented outwardly in a condition where the fixing device is mounted in the image forming apparatus. In the pressure contact state where the second fixing member is pressed against the first fixing member, downward movement of the grip allows the pressure release member to release the pressure contact state. In the pressure contact released state where the second fixing member is not pressed against the first fixing member, upward movement of the grip allows the pressure release member to press the second fixing member against the first fixing member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic front sectional view of an image forming apparatus equipped with a fixing device according to an embodiment of the present invention.

FIG. **2** is a schematic perspective view of a main part of a fixing device according to this embodiment, showing a pressure contact release state where a pressure roller is not pressed against a fixing roller.

FIG. **3** is a schematic front view of the fixing device shown in FIG. **2**, showing a pressure contact state where the pressure roller is pressed against the fixing roller.

FIG. **4** is a schematic front view of the fixing device shown in FIG. **2**, showing a pressure contact release state where the pressure roller is not pressed against the fixing roller.

FIG. **5**A is a top perspective view of a portion around one of pressure levers and one of pressure release levers in a pressure contact unit, with the pressure release lever being at a pressure position.

FIG. **5**B is a top perspective view of a portion around one of pressure levers and one of pressure release levers in the pressure contact unit, with the pressure release lever being at a release position.

FIG. **6**A is a top front perspective view of a portion around the pressure lever and the pressure release lever in the pressure contact unit, shown in section taken in the middle in the depth direction, with the pressure release lever being at the pressure position.

FIG. **6**B is a top front perspective view of a portion around the pressure lever and the pressure release lever in the pressure contact unit, shown in section taken in the middle in the depth direction, with the pressure release lever being at the release position.

FIG. **7**A is a top rear perspective view of the sections shown in FIG. **6**A, with the pressure release lever being at the pressure position.

FIG. **7**B is a top rear perspective view of the sections shown in FIG. **6**B, with the pressure release lever being at the release position.

FIG. **8** is a front top perspective view of one of the pressure levers in the pressure contact unit.

FIG. **9** is a rear bottom perspective view of one of the pressure levers in the pressure contact unit.

FIG. **10** is a top perspective view of one of the pressure release levers in the pressure contact unit.

FIG. **11** is a top right perspective view of the image forming apparatus shown in FIG. **1**, with a side cover being open.

FIG. **12** is an enlarged perspective view of a portion around a fixing device in the image forming apparatus shown in FIG. **11**.

FIG. **13** is a side view showing a schematic configuration of another image forming apparatus, in which the fixing device is mounted such that grips of the pressure release levers are oriented to a user operation side (a front face side) of the main body.

FIG. **14** is a top right perspective view showing a schematic configuration of the image forming apparatus shown in FIG. **13**.

FIG. **15** is a perspective view of the image forming apparatus shown in FIG. **13**, with a front cover being open.

DESCRIPTIONS OF PREFERRED EMBODIMENTS

Hereinafter, embodiments of the present invention are described with reference to the attached drawings.

FIG. **1** is a schematic front sectional view of an image forming apparatus **100** equipped with a fixing device **17** according to an embodiment of the present invention.

<Image Forming Apparatus>

An image forming apparatus **100** has a copying function of reading an image in an original copy G and forming an image on a recording sheet P such as a sheet of recording paper. The image forming apparatus **100** is equipped with an image scanner **200** for reading an image in an original copy G, and a main body **300** for forming an image on a recording sheet P.

The main body **300** of the image forming apparatus **100** includes a sheet feeding unit **310**, a sheet conveying unit **320**,

an image forming unit **330**, and a sheet discharge unit **340**. The main body **300** is installed horizontally.

Image data processed in the image forming unit **330** include color image data in black (K), cyan (C), magenta (M), and yellow (Y), and monochrome image data in a single color (e.g. black). In order to form four color images, the image forming unit **330** is provided with four photosensitive drums **11**, four chargers **12**, four developing units **14**, four intermediate transfer rollers **152** in a transfer unit **15**, and four drum cleaners **16**. These components constitute four imaging stations Pa, Pb, Pc, Pd which are associated with black, cyan, magenta, and yellow, respectively. In the imaging stations Pa, Pb, Pc, Pd, practically same elements are identified with same reference numerals.

Image formation in the main body **300** of the image forming apparatus **100** involves following processes. First, the intermediate transfer belt **151** in the transfer unit **15** revolves in the direction of Arrow C and causes rotation of the photosensitive drums **11**. Then, surfaces of the photosensitive drums **11** are uniformly charged by the chargers **12** at a given potential and exposed by an optical scanner **13** so as to form electrostatic latent images on the surfaces. The electrostatic latent images on the surfaces of the photosensitive drums **11** are developed by the developing units **14**, thereby forming toner images (unfixed images) on the surfaces of the photosensitive drums **11**. In this manner, toner images in four colors are formed on the surfaces of the photosensitive drums **11**. Later, residual toner on the surfaces of the photosensitive drums **11** is removed and collected by the drum cleaners **16**.

Next, while the intermediate transfer belt **151** revolves in the direction of Arrow C, the toner images in four colors formed on the surfaces of the photosensitive drums **11** are successively transferred and overlapped on the intermediate transfer belt **151** by the intermediate transfer rollers **152** to which a transfer bias is applied, thereby forming a color toner image on the intermediate transfer belt **151**. In this manner, a color toner image is formed on the surface of the intermediate transfer belt **151**. Later, residual toner on the surface of the intermediate transfer belt **151** is removed and collected by a belt cleaner **153**.

In the sheet feeding unit **310**, a recording sheet P loaded in a feeding cassette **311** is pulled out of a feeding cassette **311** by a sheet feeding roller unit **312**, and is conveyed to the image forming unit **330** via a sheet conveying path **321** in the sheet conveying unit **320**. The sheet conveying path **321** is provided with registration rollers **322**, conveying rollers **324**, and discharge rollers **325**. The registration rollers **322** temporality stop (suspend) the recording sheet P so as to align a leading end of the recording sheet P. Thereafter, the registration rollers **322** resume conveying the recording sheet P, in time with the transfer operation of the color toner image at a transfer nip region between the intermediate transfer belt **151** and a transfer roller **154***a* of a secondary transfer unit **154**.

While the recording sheet P, conveyed from the sheet feeding unit **310** via the sheet conveying path **321** in the sheet conveying unit **320** to the image forming unit **330**, is nipped in and conveyed through the transfer nip region between the intermediate transfer belt **151** and the transfer roller **154***a*, the color toner image on the surface of the intermediate transfer belt **151** is transferred on the recording sheet P by the transfer roller **154***a* to which a transfer bias is applied. The recording sheet P is then held in between a fixing roller **171** and a pressure roller **172** of the fixing device **17**, and is heated and pressed therebetween, thereby fixing the color toner image formed on the recording sheet P. The recording sheet P is further conveyed toward the sheet discharge unit **340**, and is discharged in a discharge tray **341** of the sheet discharge unit **340** through the discharge rollers **325**.

After an image is formed on the front surface of the recording sheet P, if another image is to be formed on a back surface thereof, the recording sheet P on which a toner image is fixed on the front surface by the fixing device **17** is conveyed in a reverse direction by the discharge rollers **325** toward a reverse path **323**. The recording sheet P is reversed in the reverse path **323** and guided again to the registration rollers **322**. Then, in the same manner as for the front surface of the recording sheet P, a toner image is formed and fixed on the back surface of the recording sheet P, and the recording sheet P is discharged in the discharge tray **341** of the sheet discharge unit **340**. In FIG. **1** and in FIGS. **2-15** to be described later, X represents a depth direction on the horizontal plane, Y represents a width direction on the horizontal plane orthogonal to the depth direction X, and Z represents a top-bottom (vertical) direction orthogonal to the horizontal plane.

<Fixing Device>

The fixing device **17** according to the embodiment illustrated in FIG. **1** is hereinafter described in detail.

FIG. **2** is a schematic perspective view of a main part of the fixing device **17** according to this embodiment, showing a pressure contact release state where the pressure roller **172** is not pressed against the fixing roller **171**. FIGS. **3** and **4** are schematic front views of the fixing device **17** shown in FIG. **2**. FIG. **3** shows a pressure contact state where the pressure roller **172** is pressed against the fixing roller **171**. FIG. **4** shows a pressure contact release state where the pressure roller **172** is not pressed against the fixing roller **171**.

In the fixing device **17**, one end and the other end in the depth direction X look almost identical except that the other end is a mirror image of the one end. Hence, FIGS. **2-4** and FIGS. **5A-10** to be described later illustrate only the one end in the depth direction X and omit the other end in the depth direction X. In addition, FIG. **2** further omits a main body frame FL.

The fixing device **17** is equipped with a fixing roller **171** (an example of the first fixing member) for fixing a toner image (an unfixed image composed of toner T) on the recording sheet P (see FIGS. **3** and **4**), a pressure roller **172** (an example of the second fixing member) opposed to the fixing roller **171**, and a pressure contact unit **400** for pressing the pressure roller **172** against the fixing roller **171** and releasing the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171**. With the fixing roller **171** and the pressure roller **172** being pressed against each other by the pressure contact unit **400**, the fixing device **17** forms a fixing nip region (a fixing nip part) N (see FIGS. **3** and **4**) between the fixing roller **171** and the pressure roller **172**. Detailed description of the pressure contact unit **400** will be given later.

In this embodiment, the fixing roller **171** is provided with a heat source **174**, such as a halogen heater lamp, which heats a roller surface **171***a*.

To be specific, the fixing roller **171** has its rotation shaft **171***b* rotatably held on a main body (specifically, a main body frame FL, see FIGS. **3** and **4**) of the fixing device **17** by means of bearings **177**. The fixing roller **171** has a tubular cored bar **171***c*, and is arranged to face a toner T side of the conveyed recording sheet P. The heat source **174** is provided inside the cored bar **171***c* of the fixing roller **171**. Owing to this arrangement, the roller surface **171***a* of the fixing roller **171** is heated by the heat source **174**, and the heat on the roller surface **171***a* is conducted to the toner T on the recording sheet P. Then, in a state where the pressure roller **172** is pressed against the fixing roller **171** with the interposition of the recording sheet P and the recording sheet P is held in the fixing nip region N

between the fixing roller **171** and the pressure roller **172**, the fixing roller **171** thermally fixes the toner T on the recording sheet P in cooperation with the pressure roller **172**. Although the pressure roller **172** is not provided with a heat source in this embodiment, the pressure roller **172** may be provided with a heat source.

In a state where the fixing device **17** in this configuration is mounted in the main body **300** of the image forming apparatus **100** (see FIG. **1**), a drive mechanism (such as a gear, not shown) in the main body **300** meshes with a gear (not shown) provided on the rotation shaft **171***b* of the fixing roller **171**. A rotational driving force from the drive mechanism in the main body **300** is transmitted via the gear to the rotation shaft **171***b* of the fixing roller **171**, thereby driving the fixing roller **171** to rotate in a predetermined rotation direction E1. Along with the rotation of the fixing roller **171**, the pressure roller **172** is driven to rotate in a rotation direction E2 that is reverse to the rotation direction E1 of the fixing roller **171**. The recording sheet P is conveyed between the fixing roller **171** and the pressure roller **172** in a sandwiched manner, and is heated and pressed at the fixing nip region N. Eventually, unfixed toner T on the recording sheet P is fused, mixed, pressed, and thermally fixed.

(Pressure Contact Unit)

The next description is directed to the pressure contact unit **400** provided in the fixing device **17** according to this embodiment.

The pressure contact unit **400** is equipped with pressure levers **410** (an example of the support member) which support the pressure roller **172** such that the pressure roller **172** can approach and separate from the fixing roller **171**, first pressure springs **420** (an example of the biasing member), such as coil springs, for biasing the pressure levers **410** such that the pressure roller **172** is pressed against the fixing roller **171**, and pressure release levers **430** (an example of the pressure release member) for releasing the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171**. In this context, the term "approach and separate from" means that the pressure roller **172** is allowed to move in a direction toward the fixing roller **171** and in a direction away from the fixing roller **171**.

In this embodiment, the pressure levers **410** are configured to hold the pressure roller **172** in such a manner that the pressure roller **172** can rotationally move in approaching/separating directions W relative to the fixing roller **171**, around a rotational axis extending along a rotation shaft **172***a* of the pressure roller **172** (specifically, rotational supporting points **176***a*, see FIGS. **3** and **4**). In this context, the approaching/separating directions W indicate a direction for pressing the pressure roller **172** against the fixing roller **171** and a direction for releasing the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171**.

In detail, the pressure levers **410** rotatably hold the rotation shaft **172***a* of the pressure roller **172**, and the pressure levers **410** themselves are rotatable around the rotational supporting points **176***a*. In this embodiment, the rotational supporting points **176***a* are support pins which constitute rotation shafts extending along the rotation shaft **172***a* of the pressure roller **172** and secured on the main body (specifically, the main body frame FL, see FIGS. **3** and **4**) of the fixing device **17**.

To be specific, the pressure levers **410** are composed of a pair of pressure levers **410**, **410** provided at each end of the rotation shaft **172***a* of the pressure roller **172**.

The pair of pressure levers **410**, **410** has receiver portions **411**, **411** for receiving each end of the rotation shaft **172***a* of the pressure roller **172**. In the pair of pressure levers **410**, **410**, the rotation shaft **172***a*, **172***a* at each end of the pressure roller **172** is rotatably held in the receiver portions **411**, **411** by way of bearings **440**, **440**.

The pair of pressure levers **410**, **410** is also provided with, at one end portion thereof in a predetermined direction (above the pressure roller **172** in the example shown in FIGS. **3** and **4**), latching parts **410***a* for rotatably latching the rotational supporting points **176***a*. In this embodiment, the latching parts **410***a* are through holes, through which the rotational supporting points **176***a* are rotatably inserted.

The pressure release levers **430** are composed of a pair of pressure release levers **430**, **430** which are attached one by one to the pair of pressure levers **410**, **410**. The first pressure springs **420** are composed of a pair of first pressure springs **420**, **420** which are associated one by one with the pair of pressure release levers **430**, **430**.

In the fixing device **17** shown in FIGS. **2**-**4**, the reference signs not yet mentioned will be described later.

FIGS. **5**A and **5**B are top perspective views of a portion around one of the pressure levers **410** and one of the pressure release levers **430** in the pressure contact unit **400**. FIG. **5**A shows the state where the pressure release lever **430** is at a pressure position Q1, and FIG. **5**B shows the state where the pressure release lever **430** is at a release position Q2. FIGS. **6**A and **6**B are top front perspective views of a portion around the pressure lever **410** and the pressure release lever **430** in the pressure contact unit **400**, shown in section taken in the middle in the depth direction X. FIGS. **7**A and **7**B are top rear perspective views of the sections shown in FIGS. **6**A and **6**B. FIGS. **6**A and **7**A show the state where the pressure release lever **430** is at the pressure position Q1, and FIGS. **6**B and **7**B show the state where the pressure release lever **430** is at the release position Q2. Note that FIGS. **5**A-**7**B omit the main body frame FL, the cleaning roller **173**, the intermediate supports **175**, etc.

FIGS. **8** and **9** are a front top perspective view and a rear bottom perspective view, respectively, of one of the pressure levers **410** in the pressure contact unit **400**. FIG. **10** is a top perspective view of one of the pressure release levers **430** in the pressure contact unit **400**.

In the fixing device **17** according to this embodiment, the pressure contact unit **400** is configured to move the pair of pressure release levers **430**, **430** relative to the pair of pressure levers **410**, **410** in predetermined movement directions A (see FIGS. **3** and **4**) that are set in advance so as to cause the pair of first pressure springs **420**, **420** to function (or so as to generate a biasing force by the pair of first pressure springs **420**, **420**).

To be more specific, the pressure contact unit **400** is configured to move the pair of pressure release levers **430**, **430** relative to the pair of pressure levers **410**, **410** along an imaginary line in the movement directions A (in this context, an imaginary straight line α in a straight direction, namely, the dot-dashed line $\alpha 1$ in FIG. **3**, or the dot-dashed line $\alpha 2$ in FIG. **4**). The movement directions A conceptionally include not only straight directions but also circular directions and wavy directions, and examples of the imaginary line in the movement directions A include not only an imaginary straight line but also an imaginary arc extending in circular directions, or an imaginary wavy line extending in wavy directions.

Each of the pressure levers **410**, **410** is equipped with a pair of first retaining parts **412** (see FIGS. **2**-**5**B and **7**A-**9**) for holding the corresponding one of pressure release levers **430**, **430** (a predetermined part in the corresponding pressure release lever **430**, specifically, a retention element (an element to be retained) **431** to be described later, see FIGS. **2**-**5**B **7**A, **7**B, and **10**) at the pressure position Q1 (see FIGS. **3**, **5**A,

6A, and 7A), where the pair of first pressure springs **420**, **420** functions in the movement directions A (in this situation, on the imaginary straight line α) (i.e. where the pair of first pressure springs **420**, **420** generates a biasing force). To be specific, the pair of first retaining parts **412** is composed of a pair of retaining surfaces formed on a side surface of each pressure lever **410**, opposite to the other side surface facing the fixing roller **171**.

The pair of pressure release levers **430**, **430** is provided with retention elements **431** which are held in the first retaining parts **412** in the pair of pressure levers **410**, **410** (see FIGS. **2**-**5**B, 7A, 7B, and **10**).

When the retention elements **431** are held in the first retaining parts **412** of the pair of pressure levers **410**, **410** (see FIGS. **3**, **5**A, **6**A, and 7A), the pair of pressure release levers **430**, **430** is configured to apply a biasing force by the pair of first pressure springs **420**, **420** to the pair of pressure levers **410**, **410**, and thereby to press the pressure roller **172** against the fixing roller **171**. On the other hand, when the retention elements **431** are not held in the first retaining parts **412** of the pair of pressure levers **410**, **410** (see FIGS. **4**, **5**B, **6**B, and 7B), the pair of pressure release levers **430**, **430** is configured to stay at the release position Q2 (specifically, in the state where the shafts **432** stay at the release position Q2) in the movement directions A (on the imaginary straight line α (α2) in this embodiment, see the dot-dashed line in FIG. **4**) at which position the pair of first pressure springs **420** ceases to apply the biasing force to the pair of pressure levers **410**, **410**, and thereby to release the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171**.

In this embodiment, when the pressure roller **172** is pressed against the fixing roller **171**, the pair of pressure release levers **430**, **430** (specifically, the shafts **432**) is located at the pressure position Q1 on the imaginary straight line α (α1) (see the dot-dashed line in FIG. **3**), so that the retention elements **431** are held in the first retaining parts **412** of the pair of pressure levers **410**, **410**. In this state, a biasing force of the pair of first pressure springs **420**, **420** can be transmitted to the pair of pressure levers **410**, **410** via the pair of pressure release levers **430**, **430**. Through this process, the pressure roller **172** held by the pair of pressure levers **410**, **410** can be pressed against the fixing roller **171**. On the other hand, in order to release the pressure roller **172** from the pressure contact with the fixing roller **171** while the pair of pressure levers **410**, **410** stays at the pressure position Q1, the retention elements **431** of the pair of pressure release levers **430**, **430** are released from the first retaining parts **412** of the pair of pressure levers **410**, **410**, so that the pair of pressure release levers **430**, **430** (specifically, the shafts **432**) is allowed to move to the release position Q2 on the imaginary straight line α (α2). In this state, a biasing force of the pair of first pressure springs **420**, **420** is no longer transmitted to the pair of pressure levers **410**, **410** via the pair of pressure release levers **430**, **430**. Through this process, the pressure roller **172** held by the pair of pressure levers **410**, **410** can be released from the pressure contact with the fixing roller **171**.

In this regard, the pressure contact unit **400** is configured to press the pressure roller **172** against the fixing roller **171** via the pair of pressure levers **410**, **410** with a predetermined pressure contact force F (in this embodiment, the pressing force is 254.9729 N or 26 kgf) generated by the pair of first pressure springs **420**, **420**. The pressure contact unit **400** is also configured to release the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** via the pressure levers **410** with a pressure contact force F (in this embodiment, the biasing force of the pair of first pressure springs **420**, **420** is reduced to zero).

Unlike the conventional manner of employing a cam to release the pressure contact state where the pressure roller (the second fixing member) is pressed against the fixing roller (the first fixing member), the fixing device according to this embodiment is configured to move the pair of pressure release levers **430**, **430** relative to the pair of pressure levers **410**, **410** in the movement directions A (on the imaginary straight line α in this embodiment). The pair of pressure levers **410**, **410** is provided with the first retaining parts **412** for holding the pair of pressure release levers **430**, **430** at the pressure position Q1 where the pair of first pressure springs **420**, **420** functions in the movement directions A (on the imaginary straight line α in this embodiment). The pair of pressure release levers **430**, **430** is provided with the retention elements **431** to be held in the first retaining parts **412** of the pair of pressure levers **410**, **410**. Eventually, the structure for activating the pair of pressure release levers **430**, **430** can be made of fewer components, and thereby an installation space and costs for the device can be reduced.

In this embodiment, the pair of pressure release levers **430**, **430** is provided with the shafts **432** which extend in a direction (the depth direction X in this embodiment) orthogonal to the movement directions A (along the imaginary straight line α in this embodiment). The pair of pressure levers **410**, **410** is provided with guide units **413** for supporting the shafts **432** of the pair of pressure release levers **430**, **430** reciprocably in the movement directions A (on the imaginary straight line α in this embodiment).

Owing to this configuration, the guide units **413** of the pair of pressure levers **410**, **410** can reliably reciprocate the shafts **432** of the pair of pressure release levers **430**, **430** in the movement directions A (on the imaginary straight line α in this embodiment).

To be specific, each shaft **432** is provided at an end of each pressure release lever **430**. Each guide unit **413** is provided in each pressure lever **410**, at an opposite end to the rotational supporting point **176***a* over the pressure roller **172**.

In this embodiment, each guide unit **413** has a pair of guide grooves **414** (see FIGS. **3**, **4**, **6**A, **6**B, **8**, and **9**) for guiding the shafts **432** of the pair of pressure release levers **430**, **430** in a freely movable manner in the movement directions A (along the imaginary straight line α in this embodiment). Each pair of guide grooves **414** has a pair of openings **414***a* which is open to the outside and through which the shaft **432** of the corresponding one of pressure release levers **430**, **430** is attachably and detachably inserted.

Since each pair of openings **414***a* is open to the outside and the shaft **432** of each pressure release lever **430** is attachably and detachably inserted through the openings **414***a*, the shaft **432** of each pressure release lever **430** can be easily attached to or detached from the pair of guide grooves **414** in each guide unit **413**. As a result, the shafts **432** of the pair of pressure release levers **430**, **430** can be assembled into the guide units **413** more efficiently.

To be specific, the shaft **432** in each pressure release lever **430** (see FIG. **10**) is a columnar shaft locating at an end of a main body **430***a* of the pressure release lever **430** and projecting from both side faces in the depth direction X. The pair of guide grooves **414** in each guide unit **413** (see FIG. **8**) has a pair of first guide surfaces (guide walls) **414***b*, **414***b* and second guide surfaces (guide walls) **414***c*, **414***c*. The first guide surfaces **414***b*, **414***b* are formed on both end faces in the depth direction X, and extend in the width direction Y and the vertical direction Z, spaced from each other by a predetermined first gap h1 (see FIG. **8**). The first guide surfaces **414***b*, **414***b* limit depthwise X-direction movements of the shaft **432** of each pressure release lever **430**. The second guide surfaces

414*c*, 414*c* originate from the first guide surfaces 414*b*, 414*b* at both vertical Z-direction ends thereof, and extend inwardly of the pair of guide groove **414** in the depth direction X, spaced from each other by a predetermined second gap h2 (see FIG. **8**). The second guide surfaces 414*c*, 414*c* limit vertical Z-direction movements of the shaft **432** of each pressure release lever **430**. The first gap h1 is slightly greater than a depthwise X-direction length d1 (see FIG. **10**) of the shaft **432** of each pressure release lever **430**, by such a degree that the shaft **432** can smoothly move in the width directions Y, through a space created in the depth direction X between the pair of first guide surfaces 414*b*, 414*b*. The second gap h2 is slightly greater than a depthwise X-direction length d2 (see FIG. **10**) of the main body **430***a* of each pressure release lever **430**, by such a degree that the main body **430***a* of each pressure release lever **430** can smoothly move in the width directions Y, through a space created in the depth direction X between the second guide surfaces 414*c*, 414*c*. A third gap h3 (see FIG. **8**) created in the vertical direction Z between the second guide surfaces 414*c*, 414*c* is slightly greater than a diameter ϕ (see FIG. **10**) of the shaft **432** of each pressure release lever **430**, by such a degree that the shaft **432** can smoothly move in the width directions Y, through a space created in the vertical direction Z between the second guide surfaces 414*c*.

Incidentally, if the pair of first pressure springs **420**, **420** receives a force in an unwanted direction, smooth movement of the shafts **432** in the guide units **413** is hampered.

Therefore, in this embodiment, one ends **421***a* of the pair of first pressure springs **420**, **420** (see FIGS. **3** and **4**) are hooked on the shafts **432** of the pressure release levers **430**. Second ends **422***a* of the pair of first pressure springs **420**, **420** are hooked on a member of the main body of the fixing device **17** (on the main body frame FL of the fixing device **17** in this embodiment) which serve as a support member for supporting the fixing roller **171**, such that the other ends **422***a* are positioned on the imaginary straight line α (α1) (see the dot-dashed line in FIG. **3**) in the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171**. In this context, the one end **421***a* and the other end **422***a* of each first pressure spring **420** refer to the portions to which a force is evenly applied (specifically, the portions through which a longitudinal center line of each first pressure spring **420** passes).

Alternatively, the other ends **422***a* of the pair of first pressure springs **420**, **420** may be hooked on the fixing roller **171** side of the fixing device **17** (on the main body frame FL of the fixing device **17** in this embodiment), such that the other ends **422***a* are positioned on the imaginary straight line α (α2) (see the dot-dashed line in FIG. **4**) in the pressure contact release state where the pressure roller **172** is not pressed against the fixing roller **171**, or positioned in an area between the imaginary straight line α (α1) (see the dot-dashed line in FIG. **3** and the broken line in FIG. **4**) in the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** and the imaginary straight line α (α2) (see the dot-dashed line in FIG. **4** and the broken line in FIG. **3**) in the pressure contact release state where the pressure roller **172** is not pressed against the fixing roller **171**.

According to this arrangement, the pair of first pressure springs **420**, **420** receives a less or no force in an unwanted direction. Reduction of a force in an unwanted direction enables smooth movement of the shafts **432** in the guide units **413**, and effectively prevents deterioration in durability of the pressure levers **410**, the pressure release levers **430**, and the first pressure springs **420**. This arrangement is particularly effective in the case where the movement directions A are straight directions, as in this embodiment, because deterioration in the efficiency of the spring force due to buckling of the first pressure springs **420** can be prevented.

To be specific, the pressure release levers **430** have through-holes **433** formed along the outer periphery of the shafts **432** (see FIGS. **6**A, **6**B, and **10**), and the main body frame FL of the fixing device **17** is provided with latching parts (specifically, fixing pins) FLa (see FIGS. **3** and **4**). In each first pressure spring **420**, one end portion **421** including the one end **421***a* is inserted through the through-hole **433** in the pressure release lever **430** and latched on the shaft **432**, and the other end portion **422** including the other end **422***a* is latched on the latching part FLa in the main body frame FL.

Further in this embodiment, the retention element **431** of each pressure release lever **430** has a projecting portion **431***a* which projects orthogonally to the movement directions A (orthogonally to the imaginary straight line α in this embodiment) (i.e. which projects in the depth direction X in this embodiment). Each pressure lever **410** is configured to support the shaft **432** of the corresponding pressure release lever **430** at the guide unit **413** in such a manner that the shaft **432** can freely turn about its central axis. Additionally, each pressure lever **410** has a pair of sliding contact portions **415** along which the corresponding projecting portion **431***a* is caused to slide by a biasing force of the corresponding first pressure spring **420** when the corresponding pressure release lever **430** stays between the pressure position Q1 and the release position Q2.

According to this arrangement, when the shafts **432***a* of the pair of pressure release levers **430**, **430** reciprocate in the guide units **413** of the pair of pressure levers **410**, **410** in the movement directions A (on the imaginary straight line α in this embodiment), the projecting portions **431***a* of the pair of pressure release levers **430**, **430** can move smoothly while keeping contact with the sliding contact portions **415** of the pair of pressure levers **410**, **410**. As a result, it is possible to improve user's operability in the pressure-contact operation or the pressure-release operation.

To be specific, each projecting portion **431***a* (see FIG. **10**) is a columnar projecting portion locating at an end of the main body **430***a* of each pressure release lever **430** and projecting from both side faces in the depth direction X. Each of the sliding contact portions **415** (see FIGS. **3** and **4**) is composed of a sliding contact surface extending in the depth direction X on a side surface of each pressure lever **410**, opposite to the other side surface facing the fixing roller **171**.

Further in the pair of pressure levers **410**, **410** according to this embodiment, each pair of first retaining parts **412** has a pair of first concave portions **412***a* formed in the pair of sliding contact portions **415**. The pair of first concave portions **412***a* is configured to catch the corresponding projecting portion **431***a* when the corresponding pressure release lever **430** stays at the pressure position Q1.

As described above, the first retaining parts **412** of the pair of pressure levers **410**, **410** have the first concave portions **412***a* formed in the sliding contact portions **415**, and the first concave portions **412***a* are configured to catch the projecting portions **431***a* of the retention elements **431** when the pair of pressure release levers **430**, **430** stays at the pressure position Q1. When the pair of pressure release levers **430**, **430** stays at the pressure position Q1, this simple configuration allows the projecting portions **431***a* of the pair of pressure release levers **430**, **430** to be held in the first concave portions **412***a* of the pair of pressure levers **410**, **410** in a stable and reliable manner.

To be specific, the first concave portions **412***a* of the pressure levers **410** have an arc-like (semicircular in this embodi-

ment) curved shape, whose radius of curvature is exactly or approximately the same as the radius r1 of the projecting portions **431***a* of the pressure release levers **430** (see FIG. **10**). Hence, the first concave portions **412***a* can securely catch the projecting portions **431***a*, with a greater contact area with the projecting portions **431***a*.

Further in this embodiment, each of the pair of pressure levers **410**, **410** is equipped with a pair of second retaining parts **416** for holding the retention element **431** of the corresponding pressure release lever **430** at the release position Q2.

Incidentally, when the pair of pressure release levers **430**, **430** stays at the release position Q2, the pair of first pressure springs **420**, **420** does not apply a biasing force to the pair of pressure levers **410**, **410**. Hence, if the projecting portions **431***a* of the retention elements **431** of the pair of pressure release levers **430**, **430** are not securely held in the second retaining parts **416** of the pair of pressure levers **410**, **410**, the pair of first pressure springs **420**, **420** may drop off. To prevent this accident, it is necessary to add a member for preventing the pair of first pressure springs **420**, **420** from dropping off, which complicates the configuration of the device.

In this regard, each pair of second retaining parts **416** in this embodiment has a pair of second concave portions **416***a* formed in the pair of sliding contact portions **415**. The pair of second concave portions **416***a* is configured to catch the projecting portion **431***a* of the retention element **431** when the corresponding pressure release lever **430** stays at the release position Q2.

As described above, the second retaining parts **416** of the pair of pressure levers **410**, **410** have the second concave portions **416***a* formed in the sliding contact portions **415**, and the second concave portions **416***a* are configured to catch the projecting portions **431***a* of the retention elements **431** when the pair of pressure release levers **430**, **430** stays at the release position Q2. When the pair of pressure release levers **430**, **430** stays at the release position Q2, this simple configuration allow the projecting portions **431***a* of the pair of pressure release levers **430**, **430** to be held in the second concave portions **416***a* of the pair of pressure levers **410**, **410** in a reliable manner.

To be specific, each of the second retaining parts **416** is composed of a retaining surface on a side surface of the pressure lever **410**, opposite to the other side surface facing the fixing roller **171**. The second concave portions **416***a* of the second retaining parts **416** have an arc-like (semicircular in this embodiment) curved shape, whose radius of curvature is exactly or approximately the same as the radius r1 of the projecting portions **431***a* of the pressure release levers **430** (see FIG. **10**). Hence, the second concave portions **416***a* can securely catch the projecting portions **431***a*, with a greater contact area with the projecting portions **431***a*.

Relative to the first concave portions **412***a*, the second concave portions **416***a* of the second retaining parts **416** are more distant from (downwardly of, in this embodiment) the rotational supporting points **176***a* and are nearer to the fixing roller **171**. The second concave portions **416***a* are provided such that, when the pressure release levers **430** stay at the release position Q2 (see FIG. **4**), the axis of the projecting portions **431***a* of the pressure release levers **430** is on the pressure roller **172** side relative to the imaginary straight line α (α2).

In this embodiment, the pair of pressure levers **410**, **410** is also provided with sloping convex portions **415***a* in the sliding contact portions **415**, between the first concave portions **412***a* and the second concave portions **416***a*.

As a result, when the projecting portions **431***a* of the pair of pressure release levers **430**, **430** move between the first concave portions **412***a* and the second concave portions **416***a*, the projecting portions **431***a* can slide along the convex portions **415***a* of the sliding contact portions **415** by a biasing force of the pair of first pressure springs **420**, **420**. In detail, when the projecting portions **431***a* of the pair of pressure release levers **430**, **430** move from the second concave portions **416***a* to the first concave portions **412***a*, the direction of a vector of the pressing force applied to the projecting portions **431***a* changes at the moment when the projecting portions **431***a* pass over the peaks (the top dead centers) of the convex portions **415***a*. Hence, after the projecting portions **431***a* pass over the peaks (the top dead centers) of the convex portions **415***a*, the projecting portions **431***a* are prevented from returning back to the second concave portions **416***a*. Similarly, when the projecting portions **431***a* of the pair of pressure release levers **430**, **430** move from the first concave portions **412***a* to the second concave portions **416***a*, the projecting portions **431***a* which have passed over the peaks (the top dead centers) of the convex portions **415***a* are prevented from returning back to the first concave portions **412***a*.

To be specific, in a sliding contact direction in which the projecting portions **431***a* slide along the sliding contact portions **415**, one ends of the convex portions **415***a* of the pressure levers **410** are continuous with the first concave portions **412***a*, and other ends thereof are continuous with the second concave portions **416***a*. The convex portions **415***a* are provided nearer to the first concave portions **412***a* (in the vicinity of the first concave portions **412***a*), and a radius of curvature of the convex portions **415***a* is the same as or greater than (slightly greater than) the radius r1 of the projecting portions **431***a* of the pressure release levers **430**. Owing to this design, the convex portions **415***a* of the pressure levers **410** can securely keep holding the projecting portions **431***a* of the pressure release levers **430** in the first concave portions **412***a*, and can allow the projecting portions **431***a* to slide along easily between the first concave portions **412***a* and the second concave portions **416***a*.

Incidentally, when the projecting portions **431***a* of the retention elements **431** of the pair of pressure release levers **430**, **430** stay in the second concave portions **416***a* of the pair of pressure levers **410**, **410**, the projecting portions **431***a* may drop off from the second concave portions **416***a* by moving away from the first concave portions **412***a*.

Hence, in this embodiment, each pair of the second concave portions **416***a* is provided with a pair of first regulating portions **415***b* for limiting movement of the projecting portions **431***a* of the retention elements **431** of the pair of pressure release levers **430**, **430** in a side opposite to the first concave portions **412***a*.

The presence of the first regulating portions **415***b* can effectively prevent the projecting portions **431***a* of the retention elements **431** of the pair of pressure release levers **430**, **430** from dropping off from the second concave portions **416***a* of the pair of pressure levers **410**, **410**.

To be specific, the pair of first regulating portions **415***b* is formed on a side surface of each guide unit **413** (see FIG. **8**), opposite to the side surface where the pair of openings **414***a* is formed. The first regulating portions **415***b* are composed of projections whose one ends are continuous with the second concave portions **416***a*, in a sliding contact direction in which the corresponding projecting portion **431***a* slides along the sliding contact portions **415**. Tip ends of the first regulating portions **415***b* project outwardly (toward an opposite side to the corresponding first pressure spring **420**) relative to the projecting portion **431***a* of the retention element **431**, in a state where each pressure release lever **430** stays at the release position Q2 (see FIG. **4**).

Incidentally, when the shafts **432** of the pair of pressure release levers **430**, **430** stay in the guide units **413** of the pair of pressure levers **410**, **410**, the shafts **432** may drop off from the guide units **413** by moving away from the fixing roller **171**.

Hence, in this embodiment, each guide unit **413** is provided with a pair of second regulating portions **413***a* for limiting movement of the shaft **432** of the corresponding pressure release lever **430** in a direction away from the fixing roller **171**.

The presence of the second regulating portions **413***a* can effectively prevent the shafts **432** of the pair of pressure release levers **430**, **430** from dropping off from the guide units **413** of the pair of pressure levers **410**, **410**.

To be specific, the pair of second regulating portions **413***a* of each guide unit **413** provides regulating surfaces extending in the depth direction X (see FIG. **8**). At ends of the pair of guide grooves **414** opposite to the pair of openings **414***a*, one ends of the second regulating portions **413***a* are continuous with the upper second guide surfaces **414***c*, and other ends of the second regulating portions **413***a* are continuous with the lower second guide surfaces **414***c*. These second regulating portions **413***a* can reliably limit movement of the shafts **432** in the pressure release levers **430**, **430** in a direction away from the fixing roller **171**. In this embodiment, the second regulating portions **413***a* have a semicircular curved shape, curved in the vertical direction Z, whose radius of curvature is exactly or approximately the same as the radius r2 of the shafts **432** of the pressure release levers **430**, **430** (see FIG. **10**). In other words, the pair of guide grooves **414** and the pair of second regulating portions **413***a* define a pair of U-shaped grooves together.

Further in this embodiment, the pair of first pressure springs **420**, **420** has a free length (a natural length) when the pair of pressure release levers **430**, **430** stays at the release position Q2 (see FIG. **4**).

As described above, since the pair of first pressure springs **420**, **420** has a free length when the pair of pressure release levers **430**, **430** stays at the release position Q2, the pair of first pressure springs **420**, **420** can be attached across the pair of pressure release levers **430**, **430** and the fixing roller **171** side of the fixing device, without applying a strong pressure. For example, a worker can manually attach the pair of first pressure springs **420**, **420** without a tool. Eventually, this arrangement can enhance efficiency in attaching the pair of first pressure springs **420**, **420**.

Specifically, the distance between the inner side of the one end **421***a* and the inner side of the other end **422***a* in each first pressure spring **420** is equal or approximately equal to the distance between the outer end of the shaft **432** of each pressure release lever **430** at the release position Q2 and the outer end of each latching part FLa of the main body frame FL (see the distance L in FIG. **4**).

Further in this embodiment, the pair of pressure release levers **430**, **430** is provided with grips **434** to be held by a user, at an opposite side to the shafts **432** over the retention elements **431**.

In this configuration, a user can easily operate the pair of pressure release levers **430**, **430** by holding the grips **434**. Thus, the grips **434** can enhance user's handleability of the pair of pressure release levers **430**, **430**.

To be specific, the pressure levers **410** have projecting supports **417** on a side opposite to the fixing roller **171**. The projecting supports **417** project in the movement direction A away from the fixing roller **171** and support the cleaning roller **173** for cleaning the surface of the pressure roller **172** (see FIGS. **2-4**). The cleaning roller **173** is held by the projecting supports **417** by way of a pair of intermediate supports **175**, **175** (see FIGS. **2-4**). First ends (lower ends) of the pair of intermediate supports **175**, **175** support both ends of the cleaning roller **173** in an axially rotatable manner, whereas other ends (upper ends) thereof are held in support holes **417***a* of the projecting supports **417** and are swingable around a swinging axis extending in the axial direction of the cleaning roller **173**. The cleaning roller **173** is pressed against the pressure roller **172** by a biasing member such as a coil spring (not shown). The projecting supports **417** also serve as projecting grips to be held by a user.

At the pressure position Q1, the pressure release levers **430** are configured to be in a parallel orientation in which the grips **434** are parallel or substantially parallel to the movement directions A (see FIG. **3**). At the release position Q2, the pressure release levers **430** are configured to be in an inclined orientation in which the grips **434** are inclined in the movement directions A and provide a wider space at the grip-side ends (see FIG. **4**). To be more specific, the pressure release levers **430** have their grips **434** inclined at an obtuse angle to the main body **430***a* (see FIG. **10**).

As described, since the grips **434** are in a parallel orientation when the pressure release levers **430** stay at the pressure position Q1, a user can easily apply a force to the grips **434**, and can easily shift the pressure release levers **430** from the pressure position Q1 to the release position Q2. Besides, since the grips **434** are in an inclined orientation when the pressure release levers **430** stay at the release position Q2, a user can grip one of the projecting supports (projecting grips) **417** projecting in the movement direction A (the direction away from the fixing roller **171**) with one hand and can operate one of the grips **434** with the other hand. Thus, a user can also easily shift the pressure release levers **430** from the release position Q2 to the pressure position Q1. The above-described configuration can further enhance user's handleability of the pressure release levers **430**.

In each pressure release lever **430**, a plurality of ridges **434***a*-**434***a* are provided on the surface facing the projecting support (the projecting grip) **417** of the grips **434** and on the surface opposite to the projecting support (the projecting grip) **417** of each grip **434**. In the thus configured pressure release levers **430**, the ridges **434***a*-**434***a* on the grips **434** have a non-slip function for a user holding the grips **434**.

Now, referring to an example of performing a fixing operation, if a pouch-like thick recording sheet P (P2, see FIG. **4**) such as an envelope is subjected to a fixing operation with a pressure contact force suitable for a standard (plain) recording sheet P (P1, see FIG. **3**), the thick recording sheet may suffer from creasing or other transport failures. In order to prevent such a trouble, the fixing device **17** in this embodiment is configured to change the pressure contact force between the fixing roller **171** and the pressure roller **172**, between a predetermined first pressure contact force F1 (for example, a pressure contact force for a standard recording sheet, 254.9729 N or 26 kgf in this embodiment, see FIG. **3**) and a predetermined second pressure contact force F2 smaller than the first pressure contact force F1 (for example, a pressure contact force for a recording sheet such as an envelope, 6.864655 N or 700 gf in this embodiment, see FIG. **4**).

However, in the case where the second pressure contact force F2 (a light load) is so small as to be, for example, only about a fraction (about 1/tenths) of the first pressure contact force F1 (a heavy load) (specifically, if F2 is 6.864655 N or 700 gf and F1 is 254.9729 N or 26 kgf), load setting accuracy of the pair of first pressure springs **420**, **420** tends to be worse when applying the light load than the heavy load.

In this respect, the fixing device **17** in this embodiment is further provided with a pair of second pressure springs **450**, **450** as an auxiliary biasing member.

When the pair of pressure release levers **430**, **430** stays at the pressure position Q1 (see FIG. **3**), the pressure contact unit **400** presses the pressure roller **172** against the fixing roller **171** by the pair of first pressure springs **420**, **420** with the first pressure contact force F1. When the pair of pressure release levers **430**, **430** stays at the release position Q2 (see FIG. **4**), the pressure contact unit **400** releases the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** by the pair of first pressure springs **420**, **420**, but at the same time presses the pressure roller **172** against the fixing roller **171** by the pair of second pressure springs **450**, **450** with the second pressure contact force F2 (<F1). Namely, while the pressure roller **172** is not pressed against the fixing roller **171** by the pair of first pressure springs **420**, **420**, the pressure contact unit **400** constantly presses the pressure roller **172** against the fixing roller **171** by the pair of second pressure springs **450**, **450** with the second pressure contact force F2.

In detail, the pair of pressure levers **410**, **410** is provided with latching parts (specifically, attachment holes formed in attachment parts **418**) **418***a* on the opposite side to the rotational supporting points **176***a* over the pressure roller **172** in an area surrounding the pressure roller **172** (in the lower left area relative to the pressure roller **172** in the example shown in FIGS. **3** and **4**). The main body frame FL of the fixing device **17** is provided with latching parts (specifically, attachment holes) FLb (see FIGS. **3** and **4**). First ends **451** of the pair of second pressure springs **450**, **450** are hooked on the latching parts **418***a*, and other ends **452** of the pair of second pressure springs **450**, **450** are hooked on the main body of the fixing device **17** (specifically, the attachment holes FLb in the main body frame FL).

When a user operates the grips **434** to move the pressure release levers **430** to the pressure position Q1 or the release position Q2 and thereby to stretch or compress the pair of first pressure springs **420**, **420** and the pair of second pressure springs **450**, **450**, the pressure contact unit **400** of the above-described configuration increases or decreases the pressing force for pressing the pressure roller **172** against the fixing roller **171**. In other words, when the pair of pressure release levers **430**, **430** stays at the pressure position Q1 (see FIG. **3**) (when the pressure roller **172** is pressed against the fixing roller **171** by the pair of first pressure springs **420**, **420** with the first pressure contact force F1), a user operates the grips **434** to move the pair of pressure release levers **430**, **430** to the release position Q2, so that the pressure roller **172** is pressed against the fixing roller **171** by the pair of second pressure springs **450**, **450** with the second pressure contact force F2. On the other hand, when the pair of pressure release levers **430**, **430** stays at the release position Q2 (see FIG. **4**) (when the pressure roller **172** is pressed against the fixing roller **171** by the pair of second pressure springs **450**, **450** with the second pressure contact force F2), a user operates the grips **434** to move the pair of pressure release levers **430**, **430** to the pressure position Q1, so that the pressure roller **172** is pressed against the fixing roller **171** by the pair of first pressure springs **420**, **420** with the first pressure contact force F1.

(Fixing Operation on a Standard Recording Sheet)

For a fixing operation on a standard recording sheet P (P1), the pair of pressure release levers **430**, **430** is located at the pressure position Q1 (see FIG. **3**), and the pressure roller **172** is pressed against the fixing roller **171** by a biasing force of the pair of first pressure springs **420**, **420** with the first pressure contact force F1 (254.9729 N or 26 kgf in this embodiment).

(Fixing Operation on a Thick Recording Sheet Such as an Envelope)

On the other hand, for a fixing operation on a pouch-like thick recording sheet P (P2) such as an envelope, the pair of pressure release levers **430**, **430** is located at the release position Q2 (see FIG. **4**). At this position, the pair of first pressure springs **420**, **420** turns into the pressure contact release state (where the biasing force is zero), and the pair of second pressure springs **450**, **450** generates a biasing force for pressing the pressure roller **172** against the fixing roller **171** with the second pressure contact force F2 (specifically, 6.864655 N or 700 gf).

The degree of the second pressure contact force F2, as defined herein, is such that a recording sheet P jammed in the fixing device **17** (so called "paper jam at the fixing unit") can be easily pulled out from between the fixing roller **171** and the pressure roller **172**.

In this embodiment, the first fixing member is a fixing roller, and the second fixing member is a pressure roller. Alternatively, the first fixing member may be a pressure roller, and the second fixing member may be a fixing roller. As a further alternative, one of the first fixing member and the second fixing member may be composed of a plurality of rollers including a fixing roller (for example, a fixing roller and a heating roller) and an endless fixing belt looped around the plurality of rollers, and the other one of the first fixing member and the second fixing member may be a pressure roller to be pressed against the fixing roller with an interposition of the fixing belt.

Additionally, the fixing device **17** in this embodiment is configured to turn the pressure levers **410** around the rotational supporting points **176***a*, but may also be configured to move the pressure levers **410** in straight directions for pressing the pressure roller **172** against the fixing roller **171** and releasing the pressure contact state between these rollers (i.e. in straight directions in which the pressure roller **172** approaches and moves away from the fixing roller **171**).

Next, as an example of user's operation of the grips **434** of the pair of pressure release levers **430**, **430**, we mention a case of removing a recording sheet P jammed in the fixing device **17** due to paper jam at the fixing unit, referring to FIGS. **11**-**15**.

FIG. **11** is a top right perspective view of the image forming apparatus **100** shown in FIG. **1**, with a side cover **101** being open. FIG. **12** is an enlarged perspective view of a portion around the fixing device **17** in the image forming apparatus **100** shown in FIG. **11**.

As shown in FIGS. **11** and **12**, the fixing device **17** is mounted in one side (the right face side in this example) of the image forming apparatus **100**, with a user operation side (the front face side) of the main body **300** of the image forming apparatus **100** being assumed to be the front side.

The image forming apparatus **100** is also equipped with a side cover **101** provided in a freely opening and closing manner, on the side at which the fixing device **17** is mounted (the right face side in this example).

The fixing device **17** is mounted in the right part of the main body **300** of the image forming apparatus **100**, in such a manner that the grips **434** of the pair of pressure release levers **430**, **430** are oriented outwardly (oriented to the right face side in this example). Namely, the pair of pressure release levers **430**, **430** is provided at the near side and the far side in the depth direction X, with the grip **434** of the near-side pressure release lever **430** and the grip **434** of the far-side pressure release lever **430** being oriented outwardly (oriented to the side cover **101** in this example).

The side cover **101** can freely turn about a rotation axis β (see FIG. **12**) that extends in the depth direction X, between a closed position and an open position at which the side cover **101** is closed/opened to the main body **300** of the image forming apparatus **100**. At the closed position, the side cover **101** is kept closed (parallel or generally parallel to the side face). At the open position, the side cover **101** opens by about 90° or at least 90° to the face side of the main body **300** of the image forming apparatus **100**.

With the fixing device **17** being mounted in the main body **300** of the image forming apparatus **100**, the grips **434** of the pair of pressure release levers **430**, **430** are oriented outwardly (oriented to the side cover **101** in this example). In the pressure contact state where the pressure roller **172** (not shown in FIGS. **11** and **12**, see FIGS. **3**, **4**, etc.) is pressed against the fixing roller **171** (see FIGS. **12**, **3**, **4**, etc.) with the first pressure contact force F1, if the grips **434** are moved downwardly in the vertical direction Z (specifically, pressed down), the pair of pressure release levers **430**, **430** releases this pressure contact state. In the pressure contact released state where the pressure roller **172** is not pressed against the fixing roller **171** with the first pressure contact force F1, if the grips **434** are moved upwardly in the vertical direction Z (specifically, pushed up), the pair of pressure release levers **430**, **430** causes the pressure roller **172** to be pressed against the fixing roller **171** with the first pressure contact force F1. In this manner, a user can easily perform the pressure-release operation for releasing the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** with the first pressure contact force F1, and can also easily perform the pressure-contact operation for pressing the pressure roller **172** against the fixing roller **171** with the first pressure contact force F1.

In the image forming apparatus **100** of the above configuration, paper jam at the fixing unit is detected by a sheet detection sensor (not shown) provided downstream (in the sheet conveying direction) of the fixing nip region N between the fixing roller **171** and the pressure roller **172** (see FIGS. **3** and **4**). Specifically, if the sheet detection sensor does not detect a leading edge of a recording sheet P (a downstream edge in the sheet conveying direction) or a trailing edge of a recording sheet P (an upstream edge in the sheet conveying direction) within a given time after a preset timing, the sheet detection sensor confirms paper jam at the fixing unit. If paper jam is detected at the fixing unit, the image forming apparatus **100** stops an image forming operation (a printing operation) in the main body **300** and presents an indication (so-called paper jam indication) on a display (not shown) provided at an operation side of the main body **300** so as to inform a user of the paper jam at the fixing unit. From this indication, a user can notice the paper jam at the fixing unit.

A user who noticed paper jam at the fixing unit opens the side cover **101** from the closed position to the open position, thereby exposing the grips **434** of the pair of pressure release levers **430**, **430** in the fixing device **17** that is mounted in the main body **300**. In this state, the pressure roller **172** is pressed against the fixing roller **171** with the first pressure contact force F1. If the user performs a pressure-release operation (a press-down operation) by pressing the grips **434** of the pair of pressure release levers **430**, **430** downwardly in the vertical direction Z, the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** with the first pressure contact force F1 is released. Once the pressure contact state is released, the user can easily remove a recording sheet P (a jammed sheet) stuck at the fixing nip region N between the fixing roller **171** and the pressure roller **172**.

After the user has removed the recording sheet P (the jammed sheet) easily, the pressure contact released state where the pressure roller **172** is not pressed against the fixing roller **171** with the first pressure contact force F1 is still maintained. If the user performs a pressure-contact operation (a push-up operation) by pushing up the grips **434** of the pair of pressure release levers **430**, **430** upwardly in the vertical direction Z, the pressure roller **172** is pressed against the fixing roller **171** with the first pressure contact force F1. Thereafter, the user closes the side cover from the open position in such a manner as to keep the closed position, and a normal printing operation can be resumed in the main body **300**.

In this respect, the user receives an initial load not only when the user starts to move the grips **434** in the pressure-release operation (the press-down operation) of the grips **434** of the pair of pressure release levers **430**, **430** (at an initial stage of the pressure-release/press-down operation), but also when the user starts to move the grips **434** in the pressure-contact operation (the push-up operation) of the grips **434** of the pair of pressure release levers **430**, **430** (at an initial stage of the pressure-contact/push-up operation). In this embodiment, the initial load in the pressure-release operation (the press-down operation) is set greater than the initial load in the pressure-contact operation (the push-up operation).

To be specific, as apparent from the shape of the sloping convex portions **415***a* in the sliding contact portions **415** between the first concave portions **412***a* and the second concave portions **416***a* (see FIGS. **3**, **4**, etc.), the slope angle of the sloping surfaces from the first concave portions **412***a* to the convex portions **415***a* to be traveled at the start of the pressure-release operation (the press-down operation) is greater than the slope angle of the sloping surfaces from the second concave portions **416***a* to the convex portions **415***a* to be traveled at the start of the pressure-contact operation (the push-up operation). Hence, the user receives a greater initial load at the start of the pressure-release operation (the press-down operation) than at the start of the pressure-contact operation (the push-up operation). Owing to this arrangement, even when an unexpected external force acts downwardly on the grips **434** of the pair of pressure release levers **430**, **430**, the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** with the first pressure contact force F1 is not released easily. Namely, this arrangement prevents the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** with the first pressure contact force F1 from being released by an unexpected external force acting on the grips **434** of the pair of pressure release levers **430**, **430**, but this arrangement still allows a user to apply a greater force in the pressure-release operation (the press-down operation) than in the pressure-contact operation (the push-up operation) and to perform the pressure-release operation (the press-down operation) without trouble.

On the other hand, since the initial load applied to the user at the start of the pressure-contact operation (the push-up operation) is smaller than the initial load applied to the user at the start of the pressure-release operation (the press-down operation), a user can easily perform the pressure-contact operation (the push-up operation).

FIG. **13** is a side view showing a schematic configuration of another image forming apparatus **100**A, in which the fixing device **17** is mounted such that the grips **434** of the pressure release levers **430** are oriented to a user operation side (a front face side) of the main body **300**A. FIG. **14** is a top right perspective view showing a schematic configuration of the image forming apparatus **100**A shown in FIG. **13**. FIG. **15** is

a perspective view of the image forming apparatus **100**A shown in FIG. **13**, with a front cover **101**A being open.

The image forming apparatus **100**A is equipped with a sheet feeding unit **102**, an image forming unit **103**, and a fixing device **17** according to this embodiment.

The sheet feeding unit **102** is provided at a lower part of the main body **300**A in the image forming apparatus **100**A, and feeds recording sheets P to the image forming unit **103**. The image forming unit **103**, provided above the sheet feeding unit **102**, is equipped with a photosensitive drum **103***a*, a transfer roller **103***b*, and additional elements (not shown) for performing an image forming (printing) operation, such as an electrostatic charger, an exposure unit, a developing unit, and a cleaning unit. The configurations and operations of the sheet feeding unit **102** and the image forming unit **103** are similar to those of the conventional units, and detailed descriptions thereof are omitted.

The fixing device **17**, mounted above the image forming unit **103**, fixes toner T (an unfixed image) on a recording sheet P supplied from the image forming unit **103**, while conveying the recording sheet P upwardly.

In the image forming apparatus **100**A having this configuration, an image is formed on the recording sheet P supplied from the sheet feeding unit **102**, and the image is fixed thereon in the fixing device **17**. Thereafter, the recording sheet P is discharged to the outside from a top face of the main body **300**A of the image forming apparatus **100**A.

The image forming apparatus **100**A is also equipped with a front cover **101**A provided in a freely opening and closing manner, on a user operation side (a front face side) of the main body **300**A.

The fixing device **17** is mounted in an upper part of the main body **300**A of the image forming apparatus **100**A, in such a manner that the grips **434** of the pair of pressure release levers **430**, **430** are oriented outwardly (oriented to the front face side in this example). Namely, the pair of pressure release levers **430**, **430** is located at the right side and the left side in the width direction Y, with the grip **434** of the right-side pressure release lever **430** and the grip **434** of the left-side pressure release lever **430** being oriented outwardly (oriented to the front cover **101**A in this example).

The front cover **101**A can freely turn about a rotation axis γ (see FIG. **13**) that extends in the width direction Y, between a closed position and an open position at which the front cover **101**A is closed/opened to the main body **300**A of the image forming apparatus **100**A. At the closed position, the front cover **101**A is kept closed (parallel or generally parallel to the front face). At the open position, the front cover **101**A opens by about 90° or at least 90° to the front face of the main body **300**A of the image forming apparatus **100**A.

With the fixing device **17** being mounted in the main body **300**A of the image forming apparatus **100**A, the grips **434** of the pair of pressure release levers **430**, **430** are oriented outwardly (oriented to the front cover **101**A in this example). In the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** with the first pressure contact force F1, if the grips **434** are moved downwardly in the vertical direction Z (specifically, pressed down), the pair of pressure release levers **430**, **430** releases this pressure contact state. In the pressure contact released state where the pressure roller **172** is not pressed against the fixing roller **171** with the first pressure contact force F1, if the grips **434** are moved upwardly in the vertical direction Z (specifically, pushed up), the pair of pressure release levers **430**, **430** causes the pressure roller **172** to be pressed against the fixing roller **171** with the first pressure contact force F1. In this manner, a user can easily perform the pressure-release operation for releasing the pressure contact state where the pressure roller **172** is pressed against the fixing roller **171** with the first pressure contact force F1, and can also easily perform the pressure-contact operation for pressing the pressure roller **172** against the fixing roller **171** with the first pressure contact force F1.

Other arrangements, such as detection of paper jam at the fixing unit and operations of the pair of pressure release levers **430**, **430**, are similar to those described with reference to FIGS. **11** and **12**, and detailed descriptions thereof are omitted.

The present invention should not be limited to the above-described embodiments but may be embodied in other specific forms. The above-described examples are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description. Further, all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A fixing device comprising:

a first fixing member;

a second fixing member opposed to the first fixing member;

a support member which supports the second fixing member such that the second fixing member can approach and separate from the first fixing member;

a biasing member which biases the support member such that the second fixing member is pressed against the first fixing member; and

a pressure release member which releases a pressure contact state where the second fixing member is pressed against the first fixing member,

wherein the fixing device is configured to move the pressure release member in predetermined movement directions relative to the support member such that the biasing member can function, the movement directions being set in advance,

the support member comprises a first retaining part for retaining the pressure release member at a pressure position in the movement directions at which position the biasing member functions,

the pressure release member comprises a retention element to be held in the first retaining part of the support member,

when the retention element is held in the first retaining part of the support member, the pressure release member is configured to apply a biasing force of the biasing member to the support member and thereby to cause the second fixing member to be pressed against the first fixing member, and

when the retention element is released from the first retaining part of the support member, the pressure release member is configured to stay at a release position in the movement directions at which position the biasing member ceases to apply the biasing force to the support member, and thereby to release the pressure contact state where the second fixing member is pressed against the first fixing member,

wherein the pressure release member comprises a shaft extending in an orthogonal direction that is orthogonal to the movement directions, and

the support member comprises a guide unit which supports the shaft of the pressure release member reciprocably in the movement directions.

2. The fixing device according to claim 1,
wherein the guide unit has a guide groove which guides the shaft of the pressure release member in a freely movable manner in the movement directions, and
the guide groove has an opening which is open to an outside and through which the shaft of the pressure release member is attachably and detachably inserted.

3. The fixing device according to claim 1,
wherein the biasing member has one end thereof located on the shaft of the pressure release member, and has the other end thereof located on a support member for supporting the first fixing member,
the other end of the biasing member being positioned on a first imaginary straight line extending in the movement directions in the pressure contact state where the second fixing member is pressed against the first fixing member, on a second imaginary straight line in a pressure contact release state where the second fixing member is not pressed against the first fixing member, or in an area between the first imaginary straight line in the pressure contact state where the second fixing member is pressed against the first fixing member and the second imaginary straight line in the pressure contact release state where the second fixing member is not pressed against the first fixing member.

4. The fixing device according to claim 1,
wherein the retention element of the pressure release member comprises a projecting portion which projects in the orthogonal direction that is orthogonal to the movement directions,
the support member is configured to support the shaft of the pressure release member at the guide unit in such a manner that the shaft of the pressure release member can freely turn about a central axis of the shaft, and
the support member comprises a sliding contact portion along which the projecting portion is caused to slide by the biasing force of the biasing member when the pressure release member stays between the pressure position and the release position.

5. The fixing device according to claim 4,
wherein the first retaining part of the support member has a first concave portion formed in the sliding contact portion, and
the first concave portion is configured to catch the projecting portion of the retention element when the pressure release member stays at the pressure position.

6. The fixing device according to claim 5,
wherein the support member comprises a second retaining part which holds the retention element of the pressure release member at the release position,
the second retaining part has a second concave portion formed in the sliding contact portion, and
the second concave portion is configured to catch the projecting portion of the retention element when the pressure release member stays at the release position.

7. The fixing device according to claim 6,
wherein the support member is provided with a sloping convex portion in the sliding contact portion between the first concave portion and the second concave portion.

8. The fixing device according to claim 6,
wherein the second concave portion is provided with a first regulating portion which limits movement of the projecting portion of the retention element of the pressure release member in a side opposite to the first concave portion.

9. The fixing device according to claim 1,
wherein the guide unit is provided with a second regulating portion which limits movement of the shaft of the pressure release member in a direction away from the first fixing member.

10. The fixing device according to claim 1,
wherein the biasing member has a free length when the pressure release member stays at the release position.

11. An image forming apparatus comprising the fixing device according to claim 1.

12. The image forming apparatus according to claim 11,
wherein the pressure release member comprises a grip which is oriented outwardly in a condition where the fixing device is mounted in the image forming apparatus,
in the pressure contact state where the second fixing member is pressed against the first fixing member, downward movement of the grip allows the pressure release member to release the pressure contact state, and
in the pressure contact released state where the second fixing member is not pressed against the first fixing member, upward movement of the grip allows the pressure release member to press the second fixing member against the first fixing member.

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